

JOURNAL OF THE CANADA DEPARTMENT OF AGRICULTURE
JOURNAL DU MINISTÈRE DE L'AGRICULTURE DU CANADA

MINISTER. HON. H. A. OLSON, MINISTRE

• DEPUTY MINISTER, S. B. WILLIAMS, SOUS-MINISTRE

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CANADA AGRICULTURE

FALL '68 AUTOMNE

COVER PHOTO—Combines move across the land as they gather in the fall crop.

PHOTO DE COUVERTURE—Moissonneuses batteuses en action pour la récolte d'automne.



"Canada Agriculture" is published quarterly by the Canada Department of Agriculture. Its purpose is to help keep extension workers and agri-businessmen informed of developments in research and other federal agricultural responsibilities as carried on by the various units of the Department.

Contributors, namely, professional personnel in the Department's Research, Economics, Health of Animals, and Production-Marketing Branches, Special Act Administrations (PFRA, etc.), and the Farm Credit Corporation are invited to submit their articles in either English or French.

Contributions should be addressed to the Secretary, Editorial Board, Information Division, Canada Department of Agriculture, Ottawa.

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«Canada Agriculture», publié par le ministère de l'Agriculture du Canada, paraît tous les trois mois. Ce journal a pour objectif de renseigner sur l'activité des Directions du ministère, les agronomes et les hommes d'affaires intéressés à l'agriculture.

Nos collaborateurs, du personnel professionnel des directions de la recherche, de l'économie de l'hygiène vétérinaire et de la production et des marchés, de l'administration des lois spéciales (ARAP, etc.) du Ministère ainsi que de la Société du crédit agricole peuvent, à leur gré, soumettre des articles en anglais ou en français.

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CANADA AGRICULTURE

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l'agriculture à l'échelon INTERNATIONAL

ROLLAND P. POIRIER

Il me fait plaisir de venir vous fournir quelques renseignements au sujet d'un secteur de l'activité humaine qui prend chaque jour des proportions plus considérables. Il s'agit du vaste secteur que l'on pourrait appeler: «La dimension internationale du monde agricole».

J'essaierai dès le début de cette causerie de vous donner une idée des proportions énormes de ce secteur en vous fournissant quelques chiffres grâce au tableau n° 1.

Ce tableau nous indique que le total des transactions internationales actuelles en produits agricoles peut être représenté par un chiffre de l'ordre de 25 milliards de dollars.

Malgré le volume assez élevé des transactions internationales en produits agricoles, on doit immédiatement dire qu'il existe quand même une crise alimentaire dans notre monde d'aujourd'hui et que cette crise ne sera pas éliminée dans les prochaines années. Au mois de septembre 1967, je donnais une causerie lors de l'inauguration de la Faculté d'Agriculture de Laval et j'essayais alors d'établir un bilan entre la production agricole actuelle et les besoins réels d'aliments à travers le monde. J'indiquais alors qu'il y avait présentement assez de nourriture sur notre planète pour satisfaire en moyenne aux *exigences minima* soit en calories, soit en protéines, de notre population. Ces chiffres se rapportant à des moyennes mondiales cachaient quand même une autre réalité puisqu'un certain nombre de pays dont le Canada fournissaient à leurs habitants des diètes supérieures aux exigences minima tant en calories qu'en protéines et d'autres régions étaient en déficit réel. Comme on ne peut pas prévoir le jour où tous les habitants de notre planète se satisferont des exigences minima au point de vue diète, il faut calculer les besoins actuels des zones déficitaires ainsi que la quantité de nourriture nécessaire pour combler les

the INTERNATIONAL dimension of agriculture

ROLLAND P. POIRIER

A sector of our economic life that is growing very fast is "the international dimension of agriculture". In terms of dollars, you can measure the size of this sector by a quick glance at Table 1.

Impressive? Over \$25 billion of actual international transactions relating to agricultural products aren't exactly small pickings. Still, in spite of this relatively high volume of international movement in agricul-

Dr. Poirier is Assistant Deputy Minister (Economics), Canada Department of Agriculture, Ottawa, Ont. This article is based on a paper given recently to the Bankers Summer School, University of Guelph.

Dr. Poirier est le Sous-ministre adjoint, Ministère de l'Agriculture du Canada. Causerie donnée à l'Association canadienne des manufacturiers de moulées (Est) incorporée à St-Hyacinthe, Qué.

tural products, we may ask ourselves if this is sufficient to properly feed our human population.

Recently, while contributing to a seminar on the problem of feeding mankind, I set up a balance sheet indicating, on one side, the quantity of food available in the world and, on the other side, the minimum requirements of our entire population. To my surprise, these figures on a world-wide basis showed that we have enough food to satisfy the minimum requirements of our entire population. These figures, being world averages, were somewhat misleading because by regionally breaking them down, I found that many countries, including Canada, were eating much more than the minimum requirement while other regions had real deficits.

I can't foresee the day when the richer parts of our world population will be satisfied with minimum rations. This being so, we must calculate the actual need of food in the deficient regions and be able to supply this food if we want to solve the enormous problem that is facing us. If we are to supply the deficient regions with enough food to bring their diets to the minimum requirement, we will require, approximately, an additional \$6 billion of food. In other words, to properly feed our present human population, we would need a total movement of agricultural products equivalent to approximately \$31 billion. ➤

déficits. Ces calculs indiquent qu'on pourrait combler les déficits alimentaires de la plupart des grandes régions sous-alimentées avec des déboursés de l'ordre de 6 milliards de dollars. Ainsi on peut affirmer que pour solutionner le problème alimentaire mondial il faudrait augmenter le volume des transactions internationales en produits agricoles par un montant d'environ 6 milliards de dollars.

Nous arrivons donc à un volume total d'échanges de l'ordre de 31 milliards de dollars pour satisfaire aux exigences actuelles de notre humanité.

Une telle activité économique ne peut pas se réaliser sans qu'un très grand nombre d'individus en fassent leur tâche de tous les jours et ces individus doivent se donner des structures d'organisation à tous les niveaux. Nous allons donc jeter un coup d'œil sur toutes ces structures et j'essaierai de vous indiquer la place du Canada dans ces organisations internationales.

Les trois principales organisations internationales qui s'occupent du commerce régulier des produits agricoles sont le GATT, l'OCDE et la FAO.

GATT

Ce sigle veut dire en anglais *General Agreement on Tariffs and Trade* et indique justement qu'il s'agit d'une entente entre plusieurs pays au sujet des tarifs et des conditions d'échange pour le commerce inter- ➤

TABLE NO. 1—VOLUME OF INTERNATIONAL TRADE RELATING TO AGRICULTURAL PRODUCTS 1966.

TABLEAU N° 1—QUELQUES CHIFFRES AU SUJET DU VOLUME DES TRANSACTIONS INTERNATIONALES EN PRODUITS AGRICOLES EN 1966.

Regular trade	\$ Millions \$	Échanges commerciaux
Wheat and flour.....	3,700	Blé et farine
Feed grain.....	2,500	Grains de provende
Rice.....	1,000	Riz
Edible oils.....	3,300	Oléagineux
Beef and veal.....	1,000	Boeuf et veau
Dairy products.....	1,600	Produits laitiers
Sugar.....	1,800	Sucre
Coffee.....	2,300	Café
Cocoa.....	500	Cocoa
Tea.....	500	Thé
Cotton.....	2,200	Coton
Wool.....	1,800	Laine
Other fibers.....	400	Autres fibres
Rubber.....	1,100	Caoutchouc
TOTAL REGULAR TRADE.....	23,700	TOTAL ÉCHANGES COMMERCIAUX
Other trade (estimates)		Autres échanges (estimés)
World Food Program.....	100	Programme Alimentaire Mondial
Food Aid U.S.A.....	1,000	Aide alimentaire États-Unis
Food Aid Canada.....	100	Aide alimentaire Canadienne
Food Aid other countries.....	200	Aide alimentaire autres pays
TOTAL OTHER TRADE.....	1,400	TOTAL AUTRES ÉCHANGES
GRAND TOTAL.....	25,100	GRAND TOTAL

But, to generate such activity, a large number of individuals must be mobilized and organizational structures at all levels of this activity is necessary. Let's have a quick look at some of the more important international organizations involved in this kind of activity and note Canada's relationship with them. The three most important dealing with the regular trade of agricultural products are GATT, OECD and FAO.

GATT

The General Agreement on Tariffs and Trade (GATT) deals with multilateral agreements between a certain number of countries on all conditions of exchange of different products from one country to the other. Headquarters is Geneva and there are 47 member countries (See accompanying list).

Although GATT deals with the trade of all products, I am restricting this article to agricultural products. In May 1967, a three-year period of negotiations was terminated by a new set of agreements now known as the "Kennedy Round". A small number of agricultural products were affected by the changes of the Kennedy Round but we must remember that previous GATT agreements still regulate all of the agricultural products not affected by the Kennedy Round.

Two important decisions were taken at the Kennedy Round in relation to agriculture. A group of exporting and importing nations, including Argentina, Australia, Canada, United States, Japan, Britain,

national. Ce groupe dont les quartiers généraux sont situés à Genève comprend actuellement 47 pays dont la liste est ci-jointe.

Les six pays du Marché Commun, c'est-à-dire la France, la Belgique, l'Allemagne, la Hollande, l'Italie et le Luxembourg participent ensemble aux ententes sous l'autorité de la Communauté Économique Européenne.

Au mois de mai 1967, le GATT complétait une nouvelle série d'ententes dont les négociations avaient commencé en 1964 et on a donné à cette série d'ententes le nom de «Kennedy Round». Le nombre de produits agricoles atteints par des changements de tarif au Kennedy Round était plutôt restreint mais les ententes préalables du GATT, continuent de régir les autres produits agricoles.

Ce groupe du GATT a des comités qui siègent constamment et qui examinent les différents secteurs du commerce agricole. Le GATT s'occupe aussi de voir à ce que les règlements généraux faisant partie de l'entente soient respectés.

Deux décisions importantes ont été prises lors du Kennedy Round se rapportant à l'agriculture. Un groupe de pays importateurs et exportateurs, l'Argentine, l'Australie, le Canada, les É.-U., le Japon, le Royaume-Uni, la France, l'Allemagne, l'Italie, la Belgique, la Hollande, le Luxembourg, le Danemark, la Suède, la Suisse, la Norvège et la Finlande, ont conclu un nouvel accord sur les prix du blé. Le nouvel accord prévoit pour le blé canadien une augmentation de 20 cents par boisseau pour le prix minimum et pour le prix maximum. ➤

MEMBER COUNTRIES OF GATT, OECD AND FAO

1. General Agreement on Tariffs and Trade (GATT)

Argentina	Luxembourg*
Australia	Malawi
Austria	New Zealand
Belgium	Nicaragua
Brazil	Nigeria
Canada	Norway
Ceylon	Pakistan
Chile	Peru
Czechoslovakia	Poland
Denmark	Portugal
Dominican Republic	Sierra Leone
Finland	South Africa
France*	Spain
Greece	Sweden
Iceland	Switzerland
India	The Netherlands*
Indonesia	Trinidad & Tobago
Ireland	Turkey
Israel	United Arab Republic
Italy*	United Kingdom
Jamaica	United States
Japan	Uruguay
Korea	West Germany*
	Yugoslavia

*These Common Market Countries participate as one unit in GATT deliberations under authority of the European Economic Community (EEC).

PAYS MEMBRES DE GATT, OCDE ET FAO

1. Accord général sur les tarifs douaniers et le commerce (GATT)

Afrique du Sud	Israël
Allemagne de l'Ouest*	Italie*
Argentine	Jamaïque
Australie	Japon
Autriche	Luxembourg*
Belgique	Malawi
Brésil	Nicaragua
Canada	Nigeria
Ceylan	Nouvelle-Zélande
Chili	Norvège
Corée	Pakistan
Tchécoslovaquie	Pérou
Danemark	Pologne
Espagne	Portugal
Etats-Unis	République Dominicaine
Finlande	République Arabe Unie
France*	Royaume-Uni
Grèce	Sierra Leone
Hollande*	Suède
Inde	Suisse
Indonésie	Trinidad et Tobago
Irlande	Turquie
Islande	Uruguay
	Yugoslavie

*Ces pays du Marché commun participent comme entité économique aux délibérations du GATT sous l'autorité de la Communauté économique européenne (CEE)

*II. Organization for Economic Cooperation
and Development (OECD)*

Austria
Belgium
Canada
Denmark
France
Greece
Iceland
Ireland
Italy
Japan
Luxembourg

Norway
Portugal
Spain
Sweden
Switzerland
The Netherlands
Turkey
United Kingdom
United States
West Germany
Yugoslavia*
Finland*

*Associate members

*II. L'Organisation de Collaboration
et de Développement Economique (OCDE)*

Allemagne de l'Ouest
Autriche
Belgique
Canada
Danemark
Espagne
Etats-Unis
France
Grèce
Irlande
Islande

Italie
Japon
Luxembourg
Norvège
Pays-Bas
Portugal
Royaume-Uni
Suède
Suisse
Turquie
Yougoslavie*
Finlande*

*membres associés

Reference map on next page

Carte de référence, page suivante

III. Food and Agriculture Organization (FAO)

Afghanistan
Algeria
Argentina
Australia
Austria
Barbados
Belgium
Bolivia
Botswana
Brazil
Bulgaria
Burma
Burundi
Cambodia
Cameroun
Canada
Central African Republic
Ceylon
Chad
Chile
Colombia
Congo (Brazzaville)
Congo (Democratic Republic)
Costa Rica
Cuba
Cyprus
Dahomey
Denmark
Dominican Republic
Ecuador
El Salvador
Ethiopia
Finland
France
Gabon
Gambia
Germany
Ghana
Greece
Guatemala
Guinea
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran
Iraq
Ireland
Israel
Italy
Ivory Coast
Jamaica
Japan
Jordan
Kenya
Korea

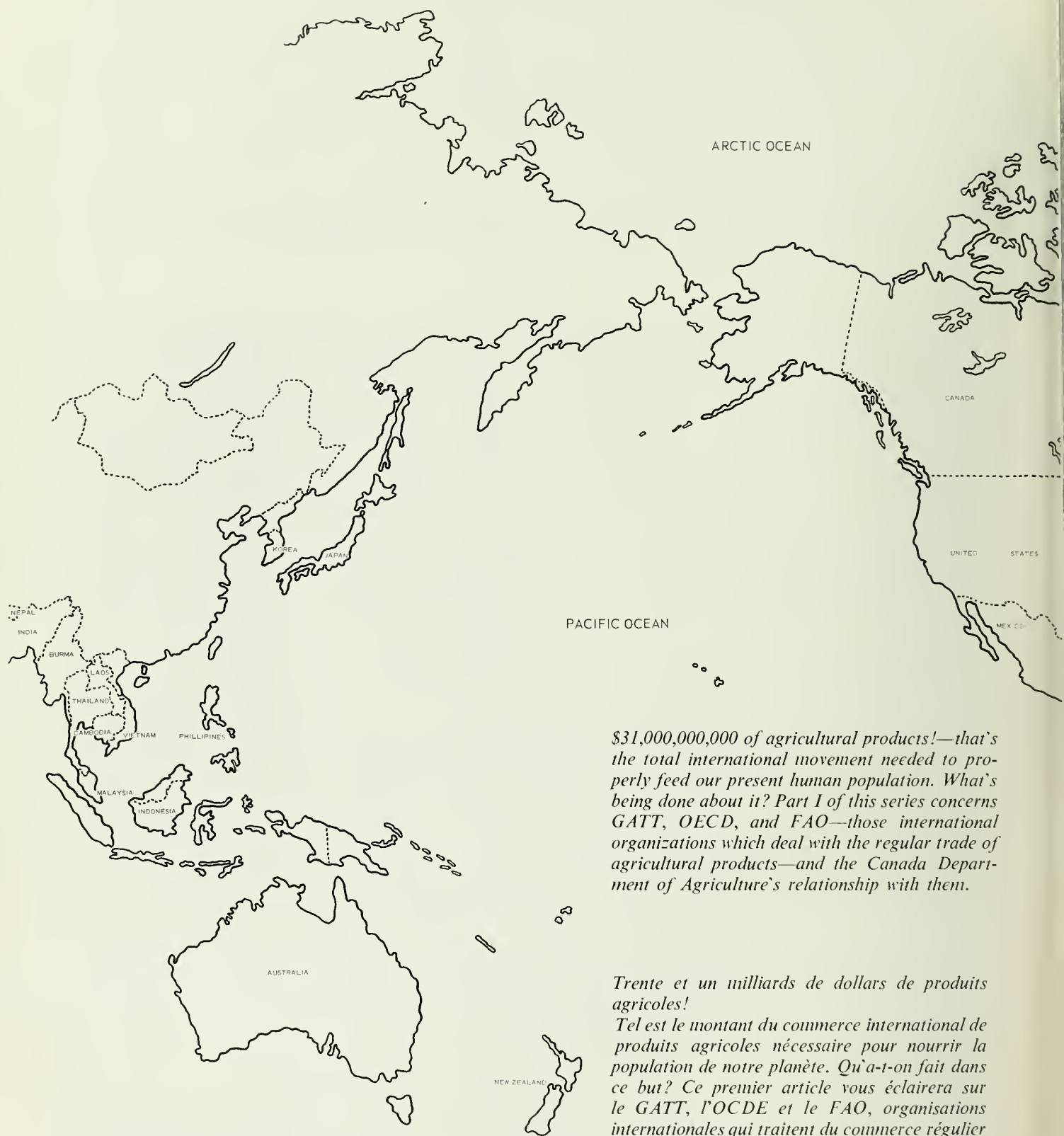
Koweit
Laos
Lebanon
Lesotho
Liberia
Libya
Luxembourg
Madagascar
Malawi
Malaysia
Mali
Malta
Mauritania
Mauritius
Mexico
Morocco
Nepal
The Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Pakistan
Panama
Paraguay
Peru
Phillippines
Poland
Portugal
Romania
Rwanda
Saudi Arabia
Senegal
Sierra Leone
Somali Republic
Spain
Sudan
Sweden
Switzerland
Syria
Tanzania
Thailand
Togo
Trinidad & Tobago
Tunisia
Turkey
Uganda
United Arab Republic
United Kingdom
United States
Upper Volta
Uruguay
Venezuela
West Vietnam
Yemen
Yugoslavia
Zambia

*III. Organisation des Nations Unies pour l'alimentation
et l'agriculture (FAO)*

Afghanistan
Algérie
Argentine
Australie
Autriche
La Barbade
Belgique
Bolivie
Botswana
Brésil
Bulgarie
Birmanie
Burundi
Cambodge
Cameroun
Canada
République centrafricaine
Ceylan
Tchad
Chili
Colombie
Congo (Brazzaville)
Congo (République
démocratique)
Costa Rica
Cuba
Chypre
Dahomey
Danemark

République Dominicaine
Equateur
El Salvador
Ethiopie
Finlande
France
Gabon
Gambie
République fédérale
d'Allemagne
Ghana
Grèce
Guatemala
Guinée
Guyane
Haïti
Honduras
Hongrie
Islande
Inde
Indonésie
Iran
Irak
Irlande
Israël
Italie
Côte-d'Ivoire
Jamaïque
Japon
Jordanie

Kenya
Corée
Koweït
Laos
Liban
Lesotho
Libéria
Libye
Luxembourg
Madagascar
Malawi
Malaisie
Mali
Malte
Maurice
Mauritanie
Mexique
Maroc
Népal
Pays-Bas
Nouvelle-Zélande
Nicaragua
Niger
Nigeria
Norvège
Pakistan
Panama
Paraguay
Pérou
Philippines
Pologne
Portugal
Roumanie
Rwanda
Arabie saoudite
Sénégal
Sierra Leone
République Somalie
Espagne
Soudan
Suède
Suisse
République arabe syrienne
Tanzanie
Thaïlande
Togo
Trinité et Tobago
Tunisie
Turquie
Ouganda
République arabe unie
Royaume-Uni
Etats-Unis
Haute-Volta
Uruguay
Vénézuéla
Viet-Nam
République arabe du Yémen
Yougoslavie
Zambie



\$31,000,000,000 of agricultural products!—that's the total international movement needed to properly feed our present human population. What's being done about it? Part I of this series concerns GATT, OECD, and FAO—those international organizations which deal with the regular trade of agricultural products—and the Canada Department of Agriculture's relationship with them.

Trente et un milliards de dollars de produits agricoles!

Tel est le montant du commerce international de produits agricoles nécessaire pour nourrir la population de notre planète. Qu'a-t-on fait dans ce but? Ce premier article vous éclairera sur le GATT, l'OCDE et le FAO, organisations internationales qui traitent du commerce régulier des produits agricoles, et sur leurs relations avec le ministère de l'Agriculture du Canada.



France, Germany, Italy, Belgium, Holland, Luxembourg, Denmark, Sweden, Switzerland, Norway and Finland, have concluded a new agreement on the prices of wheat. The minimum and maximum prices in the new agreement are 20 cents per bushel greater for our own wheat than in the previous agreement.

For the first time, within an international wheat agreement, all the participating nations have agreed to subscribe to a program of food aid for developing countries. Together, they will donate approximately 150 million bushels of wheat annually and Canada has agreed to supply 11% of this total.

At GATT headquarters in Geneva, Ad Hoc committees examine problem areas in the trading of agricultural products. There is also a permanent group which sees that the general rules of the agreement are followed by the participating countries.

Canada's collaboration with GATT is done principally by the Departments of Trade and Commerce, Finance, Agriculture and External Affairs. However, the Department of Agriculture usually deals with problems arising from irregularities in the importation of agricultural products.

OECD

The Organization for Economic Cooperation and Development (OECD), which succeeded the Marshall Plan, coordinates economic collaboration between 21 countries (see accompanying list).

OECD deals with all aspects of economic life but a large proportion of its activities are related to agriculture. One of its six directorates deals entirely with agriculture and some of the activities of the other directorates are also related to agriculture and the trade of agricultural products. Some of the activities of the directorate of agriculture are:

- harmonization of national agricultural policies;
- the position of agriculture in the process of economic growth;
- information on trade policies for agricultural products;
- analysis of market trends for short or longer periods;
- better utilization of soil and water, mobility of agricultural manpower and rural regional development;
- planification and adaptation of agricultural education and research to present and future needs;
- search for better methods of external aid in order to increase agricultural development in developing countries.

Canada is a permanent member of OECD's Agricultural Committee in Paris and always has at least one representative at all Committee meetings. Canada also has a permanent diplomatic mission in Paris to collaborate with OECD. Every second year, a ministerial meeting is held for all Ministers of Agriculture of the participating countries. Canada has always been very active in these meetings.

Pour la première fois dans l'histoire des accords internationaux pour le blé, tous les pays participants ont accepté de souscrire à un programme d'aide alimentaire pour les pays en voie de développement. Le groupe s'est engagé à fournir ensemble à peu près 150 millions de boisseaux de blé par année et le Canada a accepté de souscrire 11% de ce total.

La collaboration du Canada aux travaux du GATT pour les produits agricoles est assurée par les ministères fédéraux suivants, les Finances, le Commerce, les Affaires Extérieures et l'Agriculture. C'est ordinairement au ministère fédéral de l'Agriculture que l'on réfère les problèmes se rapportant à l'importation des produits agricoles et c'est ordinairement ce ministère qui inaugure les démarches nécessaires pour apporter des correctifs.

OCDE

Ce sigle signifie l'*Organisation de Collaboration et de Développement Économique*, nom qui décrit la collaboration organisée existant entre 21 pays indiqués sur la liste ci-jointe.

Cette organisation voit à la collaboration dans les principaux secteurs de l'économie entre tous ces pays. Une des grandes directions de l'OCDE se rapporte à l'agriculture et il y a également un département s'occupant du développement où on coordonne certaines activités agricoles se rapportant aux pays en voie de développement.

La direction de l'agriculture de l'OCDE a des activités dans les secteurs suivants:

- Harmonisation des politiques agricoles nationales*
- Analyse des principaux problèmes qui se posent aux gouvernements des pays membres dans le domaine de l'agriculture;*
- Étude approfondie de la position de l'agriculture dans la croissance économique;*
- Examen des politiques d'échange en produits agricoles*
- Analysé des tendances des marchés à court et à long terme;*
- Amélioration de l'utilisation du sol, accroissement de la mobilité de la main-d'oeuvre et encouragement au développement des régions rurales;*
- Planification et adaptation de l'enseignement et de la recherche agricole en fonction des besoins présents et futurs;*
- Assistance aux pays en voie de développement pour l'amélioration de leur agriculture et l'expansion de leur économie.*

Le Canada est membre permanent du Comité agricole de l'O.C.D.E. à Paris. Nous envoyons des représentants lors de toutes les séances d'études de ce Comité. Le Canada possède à Paris auprès de l'O.C.D.E. une représentation diplomatique permanente où certains individus s'occupent en particulier des problèmes agricoles. Il existe également à l'O.C.D.E. un Conseil des Ministres d'Agriculture des pays membres et le Canada est actif au sein de ce Conseil.

FAO

The Food and Agriculture Organization (FAO) is within the United Nations, the organization that deals with food and agriculture. FAO, with its headquarters in Rome, directs about half of its activities to problems dealing with the regular trade of agricultural products. FAO represents 117 member nations (See accompanying list).

FAO is by far the best source of world statistics relating to agriculture and to the trade of agricultural products: FAO has a very active permanent committee called the Committee on Commodity Problems which discusses and analyzes all aspects of trading in agricultural products. This committee has in recent years set up sub-committees corresponding to almost all of the important commodities such as coffee, sugar, fibers, cotton, etc. These international sub-committees are excellent forums to discuss problems particular to their own commodity and very often these sub-committees have been a first step towards international commodity agreements. The Committee on Commodity Problems, in collaboration with the World Health Organization, is presently drawing up an international agreement dealing with standards of quality and presentation for many of our food products. It is called Codex Alimentarius.

FAO has published a very complete and elaborate study dealing with projections of agricultural commodities for 1975 and for 1985. These projections will be extremely useful to all member nations.

The Canada Department of Agriculture is responsible for the coordination of all Canadian efforts in relation to the work of FAO. Other departments are also involved; Forestry, Fisheries, National Health and Welfare, Finance, Trade and Commerce and External Affairs. We send a strong delegation for the official conference of this organization which is convened every second year. Canada is a member of the FAO Council and is also a member of the Committee on Commodity Problems. Canada is a very active participant in the work of Codex Alimentarius dealing with food standards. The founding conference of FAO took place in Quebec City and since then many Canadians have been employed full-time or part-time by this organization. ■



Part II will follow in the next issue of CANADA AGRICULTURE and will deal with the multilateral and bilateral sectors of external aid for developing countries.

FAO

Ce sigle veut dire *Food and Agriculture Organization* et il est justement le nom de l'organisme des Nations Unies qui s'occupe de l'alimentation et de l'agriculture.

Cet organisme, dont le siège social est à Rome, divise d'une façon à peu près égale ses activités du moment entre le commerce régulier des produits agricoles et l'aide aux pays en voie de développement. nous allons donc décrire ici quelques-unes de ses activités se rapportant au commerce régulier.

Disons pour commencer que la FAO est constituée par 117 pays membres dont la liste est ci-jointe.

C'est la FAO qui fournit actuellement les meilleures statistiques mondiales se rapportant à l'agriculture et au commerce des produits agricoles. La FAO possède un comité permanent qui s'appelle Comité des Produits dont la principale fonction est de discuter du commerce des produits agricoles. Ce comité a mis sur pied plusieurs sous-comités se rapportant à des produits bien particuliers comme le café, le sucre, les fibres, le coton, etc. Ces sous-comités internationaux constituent des forums pour discuter des problèmes se rapportant à chacun de ces produits. Ces sous-comités ont été souvent les instigateurs d'ententes régionales et même d'ententes mondiales au sujet de ces produits.

Le Comité des Produits, en collaboration avec l'Organisation Mondiale de la Santé, rédige présentement un code international se rapportant aux normes de qualité et de présentation pour un grand nombre d'aliments. Ou l'appelle le Codex Alimentarius.

La FAO a publié l'an dernier une série de projections pour les années 1975 et 1985. Ces projections se rapportent à chacun des principaux produits agricoles.

C'est au ministère fédéral de l'Agriculture que se fait la coordination de tous les efforts canadiens vis-à-vis les travaux de la FAO. Plusieurs ministères canadiens collaborent également avec la FAO, par exemple ceux des Forêts, des Pêcheries, de la Santé, des Finances, du Commerce, et des Affaires étrangères. Nous envoyons tous les deux ans une forte délégation lors des conférences bi-annuelles de cette organisation. Le Canada fait partie du Conseil de la FAO, il fait partie également du Comité des produits agricoles. Le Canada est très actif dans les travaux du Codex Alimentarius. Disons pour terminer que la Conférence de fondation de la FAO a eu lieu au Canada, dans la ville de Québec, et depuis ce moment-là notre pays a fourni un bon nombre d'experts qui ont fait partie du personnel permanent ou temporaire de la FAO. ■

Un second article qui traitera des deux aspects, multilatéral et bilatéral de l'aide aux pays en voie de développement sera publié dans le prochain numéro de CANADA AGRICULTURE.



D. G. FARIS

Crops can be easily grown in northern Canada, and maturity of grain is not a limiting factor, if early maturing varieties are used. But, as commercial production extends northward into the agriculturally "marginal" areas, it becomes essential to shorten the period from seeding to maturity. Of the grain crops, barley holds the most potential for marginal areas as it is the earliest maturing crop and produces the greatest amount of TDN (total digestive nutrients) per day of growth. For these reasons we have singled out barley for intensive study at the CDA Research Station, Beaverlodge, Alberta.

One method of shortening the time from seeding to maturity of barley is to reduce the seeding to germination time. Rapid germination can be produced by certain cultural methods, and one of the simplest is to delay seeding, so that the seed is planted in warm soil. The effect of increasing temperatures on reduced germination time is shown in the graph.

Dr. Faris is Cerealist, CDA Research Station, Beaverlodge, Alta.

In our experiments, germination was considered complete when the shoot was as long as the seed. As the temperature was raised, the number of days required for germination decreased very rapidly, up to about 50°F, after which the rate of decrease was less.

As crop production moves into the marginal areas, a short growing season, and delayed seeding can lead to the loss of the crop in the fall, so other methods must be used to insure rapid germination. One such method is the use of varieties which germinate rapidly even at low soil temperatures.

At Beaverlodge, we examined 250 spring barley varieties, from all parts of the world, under carefully controlled conditions. The results showed more than 9 days separated the fastest from the slowest germinating types at a temperature of 39°F, but at only 2.7 days difference at a higher temperature of 54°F. This means that at low soil temperatures differences in germination rate among varieties is a much more important factor than at higher temperatures. Included in the 250 varieties were four "adapted" varieties: Husky, Olli, Parkland and Gateway. Of

these four varieties, the late variety Husky had the most rapid germination rate, while the early variety Gateway, had the slowest. Olli and Parkland gave identical germination rates intermediate between Husky and Gateway. Therefore rapid germination can be independent of early maturity. These four varieties maintained the same order of germination rates at four temperatures ranging from 39 to 82°F. This suggests that a variety which germinates rapidly at a low temperature will also germinate rapidly at a high temperature. The germination rate of Gateway, the slowest germinating variety of the four adapted varieties, was about average—based on the varieties tested. The other three were all faster than average. This indicates that these adapted varieties may have been unconsciously selected for rapid germination. It is encouraging for the plant breeder to know that there are varieties available which are still slightly faster germinating than Husky.

Tests at Beaverlodge have also shown that the location and year of seed production can greatly influence germination rate. Therefore, in comparing varieties, care had to be taken to use seed from the same source. Generally the larger and healthier the seed the more rapid the germination.

To obtain earlier emergence, certain problems and risks are associated with planting in cool soil. One problem is that cool soils favor attacks by soil micro-organisms which then infect seeds and seedlings and can cause the germinating seed to rot. These attacks can drastically cut down the number of plants that emerge and can decrease the vigor of those plants that do emerge. This reduced stand and vigor will lead to lower yields. We plan to find those barley varieties which have the most tolerance to these soil micro-organisms.

With earlier emergence, risk that seedlings will be exposed to killing frosts is increased. Unfortunately barley is one of the most frost susceptible grain crops in the seedling stage. Therefore, our plans also include a search for the most frost resistant barley strains available.

In developing an adapted barley variety with earlier maturity we plan to take the rapid germination character, such as that found in Husky, and build it into early maturing varieties such as Olli and Gateway. This early germination will be most effective under the low soil temperatures found in the north, where each day of earlier maturity can be important. Early maturity, as a measure of the whole plant growth, is usually associated with low yield. But, if earlier maturity can be obtained through more rapid germination it should give the plant a better chance in the spring; thus, it should increase, rather than decrease yield. If rapid germination is to work under cool soil conditions and risk of spring frosts, then tolerance of the germinating seed to soil borne micro-organisms and seedling resistance to frost must also be built-in. If such a variety can be pro-

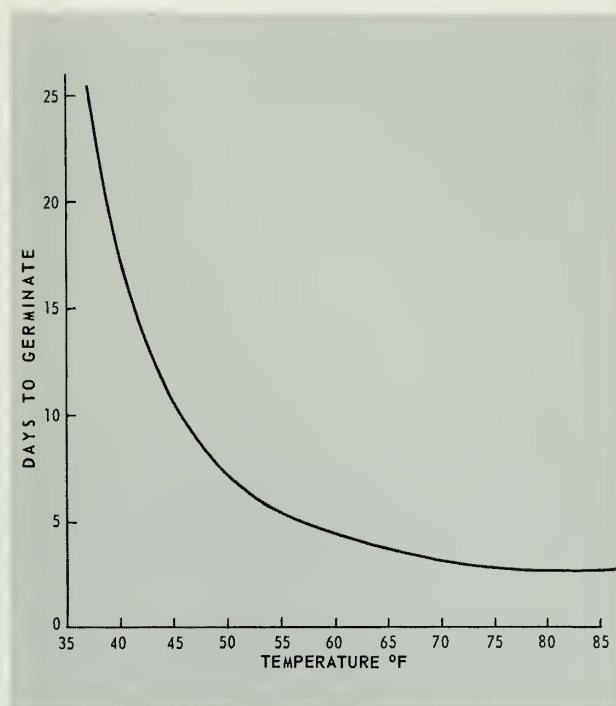


Fig. 1—Average rate of barley germination at different temperatures.

Fig. 2—germinated barley seed



duced it should be possible to obtain up to three days earlier maturity with no reduction in yield. In fact under adverse cool weather conditions, such a variety would even be expected to give increased yield.

Development of a barley variety for northern conditions is essential for the orderly development of the agriculturally marginal land in the north. The examination of the effect of temperature on the rate of germination in different barley varieties has been the first step in this program.



SOIL

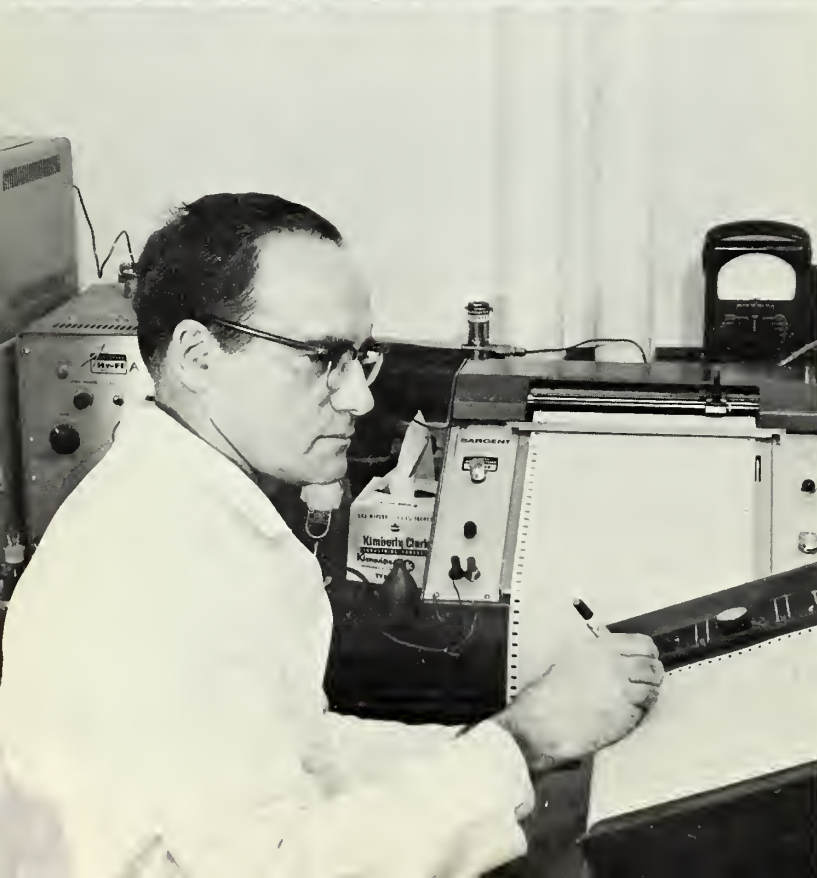


Figure 1. Oxygen consumption measurements with a differential respirometer indicate whether a soil microbe can degrade a pesticide.

Figure 2. Microplots used for studying the persistence, behaviour, and efficacy of insecticides in soils.

Figure 3. Insecticide residues are extracted from the soil with an appropriate solvent, filtered, frozen until required, and analyzed by gas chromatography as shown.

Figure 4. Insectary used for mass rearing the various species of soil insects.

To understand principles of pest and pesticide behavior in soils and to devise control measures are ultimate aims of the soil pesticide research program at the London Research Institute.

PESTICIDE RESEARCH



C. R. HARRIS

Soil insects constitute a serious problem in agriculture.

Since 1945, when DDT, the first organochlorine insecticide, was introduced, a number of related compounds, such as aldrin and heptachlor, subsequently became available. These materials were remarkably effective against all species of soil insects of economic importance. As a result, we were tempted to make blanket recommendations for controlling the soil insect complex, and unfortunately, did not take into consideration the persistence of these insecticides in soils. Moreover, in recent years it has become apparent that these materials are indeed persistent and that a number of complex side-effects are occurring which require a broad, inter-disciplinary approach to solve them. It is to this end that the program of the Soil Pesticide Section at the CDA Research Institute, London, Ont., is directed.

In our investigations, we have placed considerable emphasis on obtaining a better understanding of the biology of soil insects. We are conducting research on the climatic factors influencing the development of soil insects, with particular reference to the factors responsible for the development of diapause (overwintering stage) in root maggots and cutworms. Sufficient information on the biology of the major species of root maggots (i.e. seedcorn maggot, onion maggot, cabbage maggot, and carrot rust fly) has been obtained to enable the research team to develop mass rearing techniques for these major species of economic importance. At present cyclodiene-susceptible and resistant strains of root maggots are maintained in the laboratory. In addition, other species of soil insects of economic importance such as cutworms and crickets are cultivated on a year-round basis (Fig. 4). The mass rearing program produces 1,000 insects per day and permits extensive laboratory experiments.

Our research has revealed that the use of the cyclodiene insecticides, such as aldrin and heptachlor, results in a number of serious side effects. One of these is the development of soil insect resistance. In

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the Toxicology laboratory a project, first initiated in 1958 to accumulate base-line toxicity data in the susceptible and resistance strains of soil insects, has been completed. Levels of resistance and cross-resistance have been determined. In cooperation with Research Stations across the country, a standardized testing procedure was developed and samples of suspect strains of the various root maggot species were tested for resistance. In this way, between 1958 and the present the development of cyclodiene resistance was traced and alternative control procedures developed. At present, the root maggot species throughout Canada are generally resistant to the cyclodiene insecticides. In preparation for the development of resistance to the organophosphorus insecticides, we carry out annual checks for the development of o-p resistance and, to date, there is no evidence that soil insects are becoming resistant to the organophosphorus insecticides.

The development of alternative control measures for soil insects, necessitated by cyclodiene insecticide resistance, has proven difficult. We have found that a number of alternative organophosphorus insecticides appear to be effective. However, the degree of control obtained is often erratic and not nearly so efficient as that obtained with the cyclodiene insecticides prior to the development of resistance. Consequently, we initiated a project in the Toxicology laboratory to determine the basic factors influencing the behavior of insecticides in soils. These studies have indicated, in addition to the characteristics of the insecticide itself, that the biological activity in soil is moderated by a number of factors including soil type, soil moisture, soil temperature, and the behavior of the species of insect involved. As a result of the program, certain principles of pesticide behavior in soils are being evolved. An offshoot of our long-term basic research has been the development of a practical technique for screening potential soil insecticides. This screening program provides considerable information on materials submitted by the agricultural chemicals industry for evaluation as soil insecticides. We evaluate some 20 materials annually in this preliminary laboratory screening.

Of the initial 20 or so materials entering the primary screening program, perhaps 20 percent will warrant further testing as soil insecticides. These compounds are then included in the applied entomology program. New techniques have been developed for laboratory assessment of the efficacy of experimental materials against such insects of agricultural importance as cutworms and root maggots. Using these techniques, we work out the best methods of application and formulation, and determine tentative rates for field application. Because of the results obtained from these experiments, the number of promising experimental materials warranting field trials may have dropped to 10 percent. Thus, instead of testing 20 new materials in the field, we have by

means of laboratory experimentation been able to reduce the number requiring field trials to 2.

In co-operation with the University of Western Ontario, a Field Research Station is being developed on 15 acres of land located only a short distance from the London Research Institute. New techniques for field experimentation have been devised utilizing microplots, 1/2000 of an acre, which can be infested with the desired species of soil insect reared under laboratory conditions (Fig. 2). Pesticide-free soils of various types which have been purchased in quantity and stored at the Field Station are placed in microplots and the crops suitable for particular experiments are planted. Following prescribed treatments devised in laboratory tests, test insects are introduced into the plots, or natural insect infestation is encouraged. We assess the extent of damage at regular times. In addition, we sample the soil periodically, analyze for pesticide residues, and on harvest, sample the crops for analysis also. In this way, we can obtain a complete picture of the behavior and efficacy of an experimental compound with a minimum of effort. At present, particular emphasis is being placed on control of cutworms in tobacco, and on control of insects attacking cruciferous crops. The results of these laboratory and field screening programs will be made available to Research Stations and provincial agencies across Canada.

In addition to studies on the biology and control of soil insects, and the factors influencing the biological activity on insecticides in soils, two other aspects of the Soil Pesticide Section's research program are also receiving special attention. In a joint Toxicology-Chemistry program, laboratory and field studies are being conducted on the factors influencing the persistence and behavior of the organochlorine insecticides in soils and their uptake by crops. Particular attention is being placed on three compounds: dieldrin, heptachlor epoxide, and chlordane. Some studies are also being conducted on the persistence of organophosphorus insecticides in soils. (Fig. 3). The second aspect is being pursued in cooperation with microbiology and involves a study of the relationships between soil microorganisms and pesticides in soils. Recent important advances have involved the determination of the microorganisms which convert aldrin to dieldrin in soil; the discovery of soil microorganisms capable of degrading dieldrin; and the determination of the soil microorganisms responsible for the conversion of heptachlor to heptachlor epoxide in soil. We are also conducting studies on the influence of both the organochlorine and organophosphorus insecticides on soil microorganisms in relation to soil fertility (Fig. 1).

The ultimate aim of the soil pesticide research program of the CDA London Research Institute is to obtain sufficient understanding of the principles of pest and pesticide behavior in soils to devise control measures which provide maximum pest control with a minimum of undesirable side effects. ■

CAN HONEYBEES IMPROVE BLUEBERRY FRUIT SET?



G. W. WOOD

The role of honeybees in the pollination of lowbush blueberry has been questioned by growers for many years, and intensive studies by researchers in the Maritime Provinces and the State of Maine are continuing in order to provide an unqualified answer.

In our research at the CDA Research Station in Fredericton we have established that the plant can set up to 100% of its flowers and mature a large portion of them, but sets below 50% are the rule in most years throughout eastern Canada and the United States. Also, we know that blueberry depends upon insects, particularly bees, to accomplish pollination. However, the addition of honeybees as a supplement to the native pollinating force does not guarantee any measurable increase in fruit set.

This rather perplexing situation results from the peculiar nature of lowbush blueberry fields, as well as the behavior of honeybees themselves. To begin with, no two fields of native blueberry are similar. Some have been developed from abandoned hayfields or pasture, while others have resulted from the clearing of woodland. Field establishment of the blueberry plant is uncontrolled, except that clones (descendants produced vegetatively from a single ancestor) are encouraged to spread by periodic burning. These clones are the vegetative expansion of chance seedlings, varying in size, vigor, and productivity. Because of this high level of clonal and field variability it is difficult to assess or compare the effects of cultural treatments. This is particularly true in pollination experiments because the investigator encounters variability in both the plant stand and the density of native pollinating insects.

Perhaps the greatest expression of variability is in the inherent fertility of clones. As stated previously, some clones may set 100% of their flowers, but this must be accepted as being unusual. In a study carried out with 30 marked clones at Tower Hill, New Brunswick, the average fruit set resulting from native bee activity during a 5-year period was approximately 35%. Two clones were female sterile and produced no fruit. One clone never set higher than 17%; another never more than 26%; the

remainder consistently exceeded 50%. All clones flowered normally, produced an adequate supply of nectar, and were exposed to the same conditions of open pollination. When subjected to controlled hand pollination only six of the clones had a fruit set greater than 75%.

Another factor which contributes to variability in stands of lowbush blueberry is species composition. Most fields in eastern Canada contain a mixture of two species, *Vaccinium angustifolium* Ait. which is tetraploid, and *Vaccinium myrtilloides* Michx., which is diploid. Generally *V. angustifolium* is the dominant form but in some fields, particularly ones which have recently been developed from woodland, the two species may be present in more or less equal proportions. Pollen from the diploid species can fertilize ovules of the tetraploid species but development of the fruit ceases within 12 days after pollination.

Furthermore, investigators have observed that honeybees are not highly attracted to the small, downward hanging blueberry flower. Although the blueberry nectar is of good quality, the plant is not a good source of pollen, and many of the foraging honeybees are drawn to the flowers of other plants growing in, or adjacent to, blueberry fields. Honeybees also tend to disperse over large areas, and often the density in a field is lower than expected because the bees have spread out into adjoining blueberry fields which were not provided with colonies.

Contrary to normal behavior patterns, recent studies show that honeybee foragers are not constant for species of blueberry and visits to these flowers are often interspersed with visits to other plants. Also it was learned that individual bees may visit large numbers of flowers on the same clone before moving on to other clones. Therefore, it must be expected that many of the bees visiting blueberry do not bring about successful fertilizations because they are either not accomplishing cross pollination when necessary, or because they are cross pollinating with incompatible pollen.

Blueberry pollination is further confounded by the effects of adverse weather. Flowering is early (late May or early June in New Brunswick) and the bloom is sometimes severely damaged by frost in some areas. More often, however, crops are reduced because prolonged rains or low temperatures limit pollinator activity.

At this point in our research on blueberry pollination we must therefore conclude that honeybees have the potential of improving blueberry fruit set, but their contribution is generally difficult to measure because of the high variability in plant stands and density of native pollinators. It may be possible to improve honeybee performance in some areas through refined methods in colony management, but significant increases in set are not likely to come about without improvement in quality and uniformity in plant stands.

The author is a specialist on blueberry insects at the CDA Research Station, Fredericton, N.B.

ROP MILK MEASURING DEVICES

—The Canada Department of Agriculture's Livestock Division has approved the use of three new milk measuring devices by farmers in the Record of Performance program for dairy cattle.

This will facilitate ROP testing in large herds where pipeline equipment is used.

Two other devices were approved earlier: the Milk-O-Meter and the Milk-O-Scope. The three additional approvals were for: The De Laval Graduated Weight Jar (Model 8300719-01); the Surge Graduated Weight Jar (Model 25177); the Chore Boy Roll-O-Measure (Model 11916).

The development of reliable mechanical measuring and sampling devices has been a real breakthrough. Previously some farmers could not weigh or sample milk from each cow because the milk was being taken directly from the cow to bulk cooling tanks where it mixed with milk from other cows.

The new devices have one thing in common: they hold the milk from each cow in a separate container—usually a glass jar—where it can be weighed and a sample taken before it is drawn through the pipeline system into the bulk cooling tank.

Breeders who have installed one of the approved sampling devices will immediately be eligible for inclusion in the ROP testing program.

If cows are tested individually for milk and butterfat, the farmer can more accurately identify his best producers.

The Livestock Division tests 4,000 Canadian dairy herds monthly, providing an objective and accurate record of each cow's performance. Records are compared on a national basis to choose the best dairy cattle for breeding programs.

Although approval of the new mechanical milk measuring and sampling devices will make it easier for farmers using pipeline equipment to begin or continue ROP testing, most testing will likely continue to be done manually.

Inspectors visiting farms without pipeline equipment weigh milk with hand scales and use a tiny dipper to take samples for butterfat tests.—D. LAMBROUGHTON, OTTAWA, ONT.

AUTORISATION DE DISPOSITIFS MESUREURS DE LAIT—CONTRÔLE LAITIÈRE—La Division des bestiaux.

ministère de l'Agriculture du Canada, autorise l'emploi de trois nouveaux dispositifs mesureurs de lait par les agriculteurs qui pratiquent le Contrôle d'aptitudes des bovins laitiers de race.

Leur emploi facilitera le travail des contrôleurs dans le cas des troupeaux nombreux où la trayeuse avec canalisation est en usage.

Deux dispositifs ont été autorisés antérieurement: le Milk-O-Meter et le Milk O-Scope. Les trois nouveaux appareils sont: Le pot mesureur gradué De Laval (modèle 8300719-01); le pot mesureur gradué Surge (modèle 25177); le pot mesureur Chore-Boy Roll-O-Measure (modèle 11916).

Le perfectionnement de dispositifs sûrs de mensuration et d'échantillonnage constitue un progrès véritable. Dans le passé, certains agriculteurs ne pouvaient ni peser ni échantillonner le lait individuellement, parce que le produit était canalisé directement au réservoir réfrigérant où il se mêlait au lait du troupeau.

Les nouveaux dispositifs ont une chose en commun: ils retiennent le lait de chaque vache dans un contenant distinct, d'ordinaire un pot en verre, permettant de le peser et de l'échantillonner avant son acheminement au réservoir réfrigérant.

Les agriculteurs qui ont installé l'un des dispositifs d'échantillonnage autorisés peuvent s'inscrire immédiatement au Programme du contrôle d'aptitudes des bovins laitiers de race.

Le contrôle individuel de la production laitière et beurrière permet à l'agriculteur de reconnaître exactement ses bonnes productrices laitières.

La Division des bestiaux contrôle mensuellement 4,000 troupeaux au Canada et enregistre la production objective et exacte de chaque vache. L'ensemble des relevés sont comparés les uns aux autres pour choisir les meilleurs bovins laitiers à utiliser pour fin de reproduction.

Bien que l'autorisation des nouveaux dispositifs facilite la pratique du contrôle laitier aux agriculteurs qui emploient les installations avec canalisation, il se peut fort bien que le gros du travail des contrôleurs continuera de se faire manuellement.

Les inspecteurs visiteurs des fermes qui n'ont pas la trayeuse avec canalisation, pèsent le lait avec la balance à main et prélèvent les échantillons pour déterminer la matière grasse au moyen d'une pissette. —D. LAMBROUGHTON, OTTAWA, ONT.

IMPORT PERMITS FOR EUROPEAN

CATTLE—Permits were issued recently by the Canada Department of Agriculture for importation of 238 head of breeding cattle from Continental Europe this fall.

The cattle will first be quarantined in the country of origin and then held during the winter at the CDA's maximum security quarantine station at Grosse Ile, an island in the St. Lawrence River. (See "*Cattle Imports Call for Care*", CANADA AGRICULTURE, Spring, 1968).

The importations will include cattle from both France and Switzerland.

Of the 238 head being imported, seven will go to breeders in Nova Scotia, two head to New Brunswick, 17 to Quebec, 44 to Ontario, 15 to Manitoba, 54 to Saskatchewan, 72 to Alberta, 17 to British Columbia and 10 to the Canada Department of Agriculture.

As in past years, demand for import permits has far exceeded available space at Grosse Ile station. This year 316 breeders requested permits for 2,000 head.

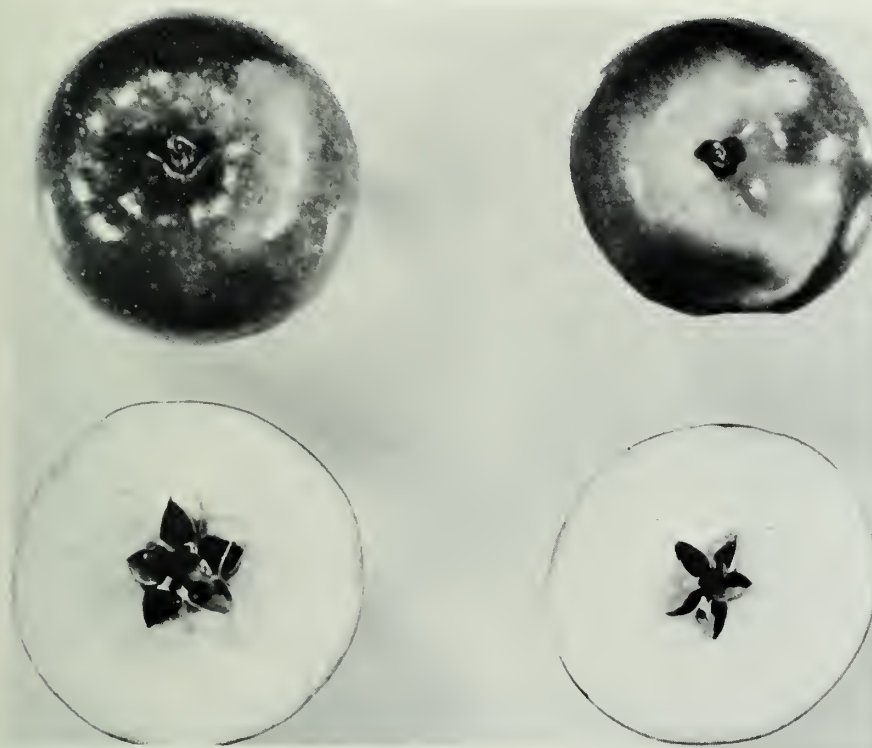
CA APPLE STORAGE IN BRITISH COLUMBIA—Use of controlled atmos-

phers (CA) storage for apples has increased sharply in British Columbia in the past few years. The first commercial CA storage in the province was opened on a trial basis for McIntosh apples in 1956. But the trend to this type of storage in B.C. did not really begin until 1963 and it followed additional experimental work at the CDA Research Station, Summerland, B.C., that showed the value of CA for storing Spartan and Delicious as well as McIntosh apples.

By the 1967-68 storage season, facilities in the Okanagan Valley—where the province's apple production is concentrated—had expanded to the point where 39 CA storage rooms provided a capacity for 933,700 bushels. Further expansion is planned for next year. (The combined capacity of all CA apple storage facilities in Canada currently amounts to more than 3.4 million bushels).

There is no doubt that the controlled atmosphere method is much more effective than regular cold storage in preserving the quality of apples that are stored for marketing in late winter and spring.

The superiority of CA storage has been shown in tests with McIntosh apples at the Summerland station. The fruit kept under controlled atmosphere retained good quality and appearance even when held as late as May and it remained free of deterioration for days after being removed from storage. But McIntosh apples kept in regular cold storage for the same time were unfit for sale and their condition rapidly deteriorated still further on removal from storage.—S. W. PORRITT, SUMMERLAND, B.C.



At left is a McIntosh apple from regular cold storage with late season browning around the core and discolored skin caused by scald. Comparable fruit (right) from Controlled Atmosphere storage is free from disorders and presents a fresh appearance of skin and flesh (story left)

La pomme McIntosh, (à gauche) a été tirée d'un réfrigérateur conventionnel. On relève aisément la détérioration de la chair et l'enveloppe fanée. Le fruit à droite a par contre, été conservé dans un atmosphère contrôlée. Il a retenu l'entrepôt à toutes ses couleurs et sa consistance. (voir audessous)

ENTREPOSAGE DES POMMES SOUS ATMOSPHÈRE CONTRÔLÉE EN COLOMBIE-BRITANNIQUE

—L'utilisation des entrepôts à atmosphère contrôlée pour les pommes a considérablement augmenté en Colombie-Britannique au cours des quelques dernières années. Le premier entrepôt commercial à atmosphère contrôlée dans la province a été inauguré à titre d'essai, pour les pommes McIntosh, en 1956. Toutefois, la tendance à ce type d'entrepôts, en Colombie-Britannique, n'a véritablement commencé qu'en 1963. Elle a suivi d'autres expériences qui se sont faites à la station de recherches du Ministère de l'Agriculture du Canada, à Summerland C.-B., et qui ont démontré la valeur de l'atmosphère contrôlée pour l'entreposage des Spartan et des Délicieuse aussi bien que des pommes McIntosh.

Au cours de la saison d'entreposage 1967-1968, les installations de la vallée de l'Okanagan, où se trouve concentrée la

production de pommes de la province, ont augmenté au point qu'on y trouve maintenant 39 entrepôts frigorifiques à atmosphère contrôlée d'une capacité globale de 933,700 boisseaux avec possibilité d'expansion l'an prochain (la capacité combinée de toutes les installations d'entreposage à atmosphère contrôlée au Canada s'élève présentement à plus de 3.4 millions de boisseaux).

Il n'y a pas de doute que la méthode à atmosphère contrôlée est beaucoup plus efficace que celle des entrepôts réfrigérés conventionnels pour conserver la qualité des pommes entreposées pour la vente en fin d'hiver.

La supériorité des entrepôts à atmosphère contrôlée a été démontrée au cours d'essais faits avec des pommes McIntosh à la station de Summerland. Les fruits gardés sous atmosphère contrôlée conservent leur bonne qualité et leur belle apparence même lorsqu'on ne les en sort

qu'en mai, et ne se détériorent pas pendant de nombreux jours après leur sortie. Par contre, des pommes McIntosh gardées dans des entrepôts réfrigérés durant la même longueur de temps, n'étaient pas vendables et leur état s'est détérioré davantage en les sortant.—S. W. PORRITT, SUMMERLAND, C.-B.

NEW BROMEGRASS VARIETY—

Magna, a versatile new variety of brome-grass that offers good forage production and high seed yield, has been developed and licensed by the Canada Department of Agriculture.

The variety is a product of a cooperative breeding program carried out at the CDA research stations at Saskatoon and Mel-fort, and at its experimental farm at Indian Head, Sask.

Magna, so named because of its tall growth and large stems and seeds, is an intermediate southern-northern type in contrast to the northern type usually found in western Canada. It combines the good forage production of the southern type of brome-grass with the high seed yield of the northern type.

The result of selection begun in 1946 within the Fischer variety from Iowa and from crosses between selected northern and southern strains, Magna has performed well in tests.

In Western Canada trials, the variety's hay yields topped those of northern common by 13% and Carlton by five to 10%. In seed yield, it equalled Carlton and surpassed northern common by 29%. In comparison, seed yields of the southern varieties Repatch and Saratoga amounted to only 60% of northern common.

Magna outperformed both Northern common and Carlton in tests in Ontario, Quebec, Wisconsin and Minnesota. It is hoped that the trend away from Western Canadian brome-grass will be reversed, thereby the introduction of the new variety.

The generally good quality of Western Canadian brome-grass seed is maintained by Magna.

Magna has been accepted by the Canadian Forage Seed Project for multiplication. In anticipation of its release as a variety seed of the strain was increased at the Indian Head farm between 1963 and 1967. This provided 1,300 lbs. of Foundation seed for release to seed growers this spring for production of Certified seed which should be available for planting hay and pasture fields in the fall of 1969.—R. P. KNOWLES, SASKATOON, SASK.

K. J. JENKINS AND M. HIDIROGLOU

Selenium is both a poison and an essential nutrient for livestock.

Selenium is a non-metallic element of the sulfur family discovered a century and a half ago by the famed Berzelius, who named it after Selene, the Greek goddess of the moon. The chemical properties of selenium compounds closely resemble those of sulfur.

SELENIUM TOXICITY

The first record of selenium poisoning in livestock appears to be one made by Dr. Madison, an army surgeon with the U.S. cavalry in Nebraska Territory, 1856. He described the occurrence of a fatal disease in horses, characterized by loss of hair from mane and tail and soreness of the feet. Later, early settlers in the same area found similar disorders among grazing stock and livestock fed grains and roughages.

Little was known about the cause of the disease until early in 1929 when Franke, a soil chemist, discovered that the toxic grains and grasses contained high levels of selenium. Further studies revealed that certain species of weeds, eaten by livestock when good pasture was scarce had the unusual property of accumulating enormous quantities of selenium. The problem became so serious that extensive soil surveys were undertaken over vast areas. These investigations disclosed that selenium toxicity areas occurred in many of the western states including Colorado, the Dakotas, Nebraska, Wyoming, Kansas and in some southern areas of Saskatchewan and Alberta. Later, seleniferous areas were reported in Ireland, Israel, northern Australia, and in the Soviet Union. Over the years the spread of knowledge has largely eliminated selenium toxicity as a threat to livestock production, but nevertheless a popular misconception that the element has cancer producing properties in animals has helped maintain its role as a culprit even to this day.

ESSENTIAL NUTRIENT

About 10 years ago attention was suddenly focused on a beneficial role for selenium in animals. Laboratory experiments with synthetic diets revealed that trace amounts of selenium prevented a fatal liver disease in rats and mice, as well as a blood vessel disorder in chicks. These disclosures set in motion a series of rapid advances in animal nutrition. Particularly striking reports appeared from New Zealand where large areas were found deficient in selenium. Administration of minute doses of selenium compounds was found to cure such nutritional disorders as white muscle disease in cattle, sheep, horses and swine, and exudative diathesis in poultry. Selenium treatment was also credited for correcting many cases

Dr. Jenkins specializes in the biochemistry, and Dr. Hidioglou in the nutrition of white muscle disease with the Animal Research Institute, Ottawa, Ont.

SELENIUM

POISON AND ESSENTIAL NUTRIENT



of ill thrift, infertility, and chronic scouring. These exciting findings provided a great impetus to further studies on the metabolic functions of vitamin E with which selenium was found to be intimately related.

WHITE MUSCLE DISEASE

The most widely recognized and clearly defined selenium deficiency is nutritional muscular dystrophy or white muscle disease (WMD), a disorder which attacks lambs and beef calves primarily. This disease has been reported in all the major sheep producing countries of the world including Australia, Canada, New Zealand, South Africa, Turkey, Great Britain, and the United States. Of the 50 American States, 32 have reported WMD in lambs and beef calves. WMD occurs most frequently in young calves and lambs within a few weeks after they have been turned out to pasture. On some farms, dystrophy develops earlier, in animals that are still housed. The first symptoms are varying degrees of stiffness in the leg muscles; later, severely affected animals are unable to rise, walk, and suckle. Death usually results from pneumonia or secondary infections owing to the weakened condition of the animal. In calves, sudden and unpredictable deaths may occur from heart muscle damage.

Although a comprehensive survey has not been

conducted for Canada, it is apparent from the information at hand that WMD may be a disease of considerable economic importance in this country. The disorder has been reported among beef cattle in the Kapuskasing, Bruce Peninsula and Manitoulin Island areas of Ontario, in the proximity of Nappan, Nova Scotia, and sporadically in areas of Alberta and British Columbia. Naturally occurring dystrophy has also been observed in dairy cattle in the Winchester, Ontario area and recently found in pigs raised in Newfoundland and Alberta.

CDA RESEARCH

For several years work has been underway at the CDA Research Branch, Ottawa, and the Kapuskasing Experimental Farm in northern Ontario to determine the factors involved in the development of muscle disorders in farm animals raised under Canadian conditions. In Kapuskasing and adjacent areas, a main contributing factor to the development of dystrophy has been found to be the very low level of selenium in the soil. During the summer of 1966, six species of forage crops were examined for selenium content. Based on average values for the season, the ranking of the six forage species, by order of decreasing selenium content were: reed canary grass, creeping red fescue, orchard grass, brome grass, timothy, and birdsfoot trefoil. All plants sampled contained less



Fig. 1—Calf with stiffness in legs produced by muscular dystrophy.

Fig. 2—WMD in a 2-month old calf with labored breathing because of heart muscle degeneration.

selenium than required for the protection of beef calves against WMD. A study was then conducted to determine whether forages in the selenium-deficient area are capable of synthesizing chemical forms of the element which are active against WMD. Radioactive selenium was sprayed onto bromegrass leaves and one week later the leaves were collected, macerated, and treated chemically for the separation and identification of the selenium compounds formed. Virtually all of the selenium radioactivity was found in the selenium amino acids which when fed to young lambs were very well absorbed and metabolized. These results show that the development of dystrophy in the Kapuskasing area is not related to an inability of the forages to take up selenium and form active compounds, but mainly to the very low selenium content of the soil.

Recently experiments were conducted with beef cattle to determine the relation of climatic conditions and exercise to the development of WMD. The progress of the disease was followed by serum levels of the enzyme glutamic oxalacetic transaminase, clinical signs, and histological examinations of muscle biopsies. It was found that calves born in the fall from beef cows fed dystrophy-producing hay were susceptible to WMD at a very early age when exposed to outwintering conditions. On the other hand, very few of the selenium deficient calves that were housed during the winter developed the disease. Calves born in the spring from dams fed dystrophy-producing hay during the winter developed WMD when they were released to pasture. Oddly enough, the incidence of dystrophy was higher in calves that had been reared outside and allowed normal exercise rather than in those closely confined indoors. This was particularly evident for the most rapidly growing crossbreeds. These results suggest that the development of WMD in calves after their release to pasture in the spring is not related to an increase in their physical activity or to a change in climate as the calves kept outside throughout the study didn't experience sudden changes in these conditions. Furthermore, it is also not due to a change of diet since WMD developed in calves whether their dams were continued on the winter hay or zero-grazed with pasture. In both cases the only nourishment the calves received was their dam's milk. During the growth of the calves, the selenium content of the tissues was found to decrease steadily. It is probably of considerable importance for the onset of dystrophy that the selenium stores are reduced below a critical level. Nevertheless, since the calf receives only its dam's milk during the dystrophy-developing period, we are investigating the possibility that a change in the composition of the milk, aside from its selenium content, may also influence the development of the disease.

Several unexpected clues have appeared that indicate that there are more factors than selenium and vitamin E involved in the WMD problem. In

the fall of 1965, an extensive experiment was carried out involving the feeding of selenium deficient forages to 108 beef cows. It was found that cows fed hay or grass-legume silage had numerous calf deaths from WMD whereas no calf mortalities occurred in the group with dams fed oat silage. The selenium contents of all the forages were very low and similar as were the selenium levels of all the calf and cow tissues. No differences were found in the tissue vitamin E levels either. This experiment was repeated in 1967 and similar results were obtained again. This protective action of oat silage against WMD is not understood at present. We consider that part of the answer may lie in the grossly different fatty acids contained in grass and cereal silage as these substances are known to affect the metabolism of selenium and vitamin E in animals.

PREVENTION OF WMD

The addition of cobalt to the soil has been a practical method of preventing deficiency of this element in animal feeds; however, this is not feasible for selenium. Only a small amount of selenium applied to the soil is taken up by most plants and there are many types of soils which cause the formation of insoluble forms of selenium not available to plants at all. Current regulations in Canada and the U.S.A. do not permit the deliberate addition of selenium to animal feeds. This is partly due to the present classification of selenium as a cancer-producing agent, the scientific basis of which has been widely disputed and is being re-evaluated at the present time. Similarly it is not possible to include selenium in the salt mix offered to sheep and cattle although there are good indications that this is a particularly feasible method and is already being employed in several countries. In this regard, during the past year research workers showed that feeding selenized salt does not result in excessive accumulation of selenium in lamb tissues and reported that in many cases the selenium levels were higher in the tissues of lambs eating a variety of practical rations. They concluded that in view of the large latitude between the protective and toxic levels of selenium (1 to 50) and the successful and routine addition of other trace elements to salt mixes, the inclusion of a trace amount of selenium in the salt mix should be a safe and effective way of administering the element.

At the present, the usual precautions taken to prevent the development of WMD in calves and lambs is the injection of a selenium-vitamin E mixture into the dam near the beginning and end of pregnancy, and a single dose to the young a few weeks after birth. Obviously this can represent a costly outlay for the livestock producer. It is hoped that the studies presently underway at the CDA laboratories will yield further knowledge of why selenium is important to animal health, and will lead to new and practical methods of preventing the disease. ■

L. J. FISHER

Would the high-yielding, disease-resistant, annual forage developed in the southern and central United States, by crossing sudan grass with sorghum, have possibilities in Canada? The CDA Research Branch is investigating.

The Agronomy Section of the CDA Ottawa Research Station tested the sorghum-sudan hybrid and found that it produced equivalent dry matter yields and higher yields of protein when compared to corn grown under the same conditions. This prompted the CDA Animal Research Institute to extend the study and compare the two forages by feeding as silages to lactating cows and measuring dry matter intake, digestibility, body weight change, and milk production.

In the study at ARI, we fed sorghum-sudan silage to nine cows in early lactation for a nine-week test period—then switched them to corn silage, continuing the feeding trial for an additional six weeks. We also fed concentrate, 1 lb. for 4 lb. of milk produced, and 5 lb. of hay daily during the 15-week trial.

DRY MATTER INTAKE

What happened? Initially, we found that dry matter (DM) intake of the sorghum-sudan silage was lower than corn silage. This difference in acceptability, most pronounced during the preliminary period, reversed itself about the seventh week of the feeding trial (Fig. 1). The same illustration shows that a sharp but transient decrease in silage intake occurred when we switched the cows from sorghum-sudan silage to corn silage. For the balance of the experiment, the same cows consumed a larger amount of corn silage than those fed corn silage for the entire trial.

DIGESTIBILITY

The reason for the difference between silages in dry matter intake was partially clarified by the digestibility trial. Dry matter digestibility (as determined in trials using sheep) of corn silage was 73 percent as opposed to 63 percent for sorghum-sudan silage. This means that for every 100 lb. of corn silage consumed by the cows, 73 lb. were utilized for maintenance and production compared with 63 lb. per 100 lb. of sorghum-sudan silage consumed. The apparent digestibility of protein was, however, greater for sorghum-sudan silage, the latter's percentage being 63.7 compared with 58.6 for corn.

MILK YIELDS AND BODY WEIGHT

Although average milk yields for previous years

Dr. Fisher is a specialist in dairy cattle nutrition at the CDA Animal Research Institute, Research Branch, Ottawa, Ont.

SORGHUM-SUDAN SILAGES . . .

How Do They Compare With Corn Silage When Evaluated On The Basis Of Dry Matter Intake, Digestibility And Milk Production?

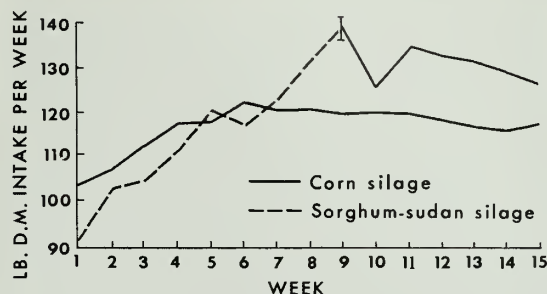
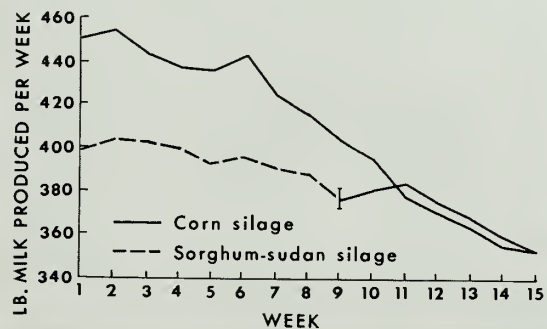


Fig. 1—Silage dry matter (D.M.) intake as influenced by type of silage fed.

Fig. 2—Milk production as influenced by type of silage fed.



were nearly identical for the two groups, the cows fed sorghum-sudan silage were initially much lower in production (Fig. 2). This relationship continued throughout the nine-week feeding trial, 51.7 vs 48.2 pounds of milk per day for corn and sorghum-sudan silages respectively. We weighed the cows on three consecutive days at the beginning and end of the initial feeding period. Those fed corn silage gained on the average 23.5 pounds while those given sorghum-sudan lost 15.4 pounds during the nine weeks.

From this study, we concluded that sorghum-sudan silage fed during the peak of lactation is deficient in energy and to maintain maximum milk production would require a higher level of cereal supplementation than corn silage. The study also indicated that cows take longer to adapt to rations containing sorghum-sudan silage. However, the high nitrogen content of sorghum-sudan coupled with a relatively high protein digestibility suggests that this forage crop may be employed in ruminant rations to minimize the need for supplementary protein. ■

D. SIMINOVITCH AND W. BALL

Specially manufactured protein foam—similar to those used in fire fighting—appear to be a practical possibility in protecting vegetables and fruit from early frost. The CDA Cell Biology Research Institute at Ottawa recently conducted successful experiments employing such foams but emphasizes that they are still in the exploratory stages.

The critical experiments were carried out early in October when frosts were forecast. Ten rows of 100 feet each of tomato plants constituted the test block. Foam was ejected by air pressure through a special nozzle and hose over the foliage in form of bands 18 to 20 inches wide and two to five inches thick.

Two or three parallel bands were required to cover each alternate row completely. The remaining rows not covered served as controls. Applied at 3-4 p.m. on one day the foam persisted with few fissures and no collapsing for 18 hours. The foam is stable and remains well in excess of the period required for practical frost protection.

Dr. Siminovitch is a specialist in winter hardiness at the Cell Biology Research Institute, CDA Research Branch, Ottawa, and Dr. Ball is with the Department of National Health and Welfare, Ottawa.

D. SIMINOVITCH ET W. BALL

Des mousses spéciales fabriquées à base de protéine—semblables à celles employées dans la lutte contre les incendies—peuvent constituer, semble-t-il, un moyen pratique de protéger les fruits et les légumes contre les gelées précoces.

L'Institut de recherches en biologie cellulaire du ministère de l'Agriculture du Canada, vient de réaliser des expériences couronnées de succès à l'aide de ces mousses, lesquelles sont toutefois encore à l'essai.

Les essais en question ont eu lieu avec des tomates au début d'octobre, à l'annonce immédiate des gelées. Le champ expérimental comportait dix rangs de cent pieds de long. La mousse a été appliquée sur le feuillage, par un tuyau à ajutage spécial, en bandes de 18 à 20 pouces de largeur et deux à cinq d'épaisseur. Il a fallu deux ou trois de ces bandes parallèles pour couvrir une rangée et l'on a alterné les lignes traitées avec les lignes témoin. Le traitement, effectué vers 3 ou 4 heures de l'après-midi, a subsisté pendant 18 heures

Dr Siminovitch, spécialiste en cryobiologie, Institut fédéral de la recherche en biologie cellulaire, Ottawa.

Dr Ball du ministère de la Santé et du Bien-être, Ottawa.

FOAMS

PREVENT
FROST DAMAGE

MOUSSES

PROTECTRICES
CONTRE LA GELÉE





Protein foam blown onto tomatoes protects them from early frosts.

Une mousse à base de protéine appliquée sur un champ de tomates protège les plants contre les gelées hâtives.

The effectiveness of the tests was determined by temperature readings and an evaluation of plant survival. Temperature recordings at five inches above the soil, and outside the leaf canopy, were 25 degrees Fahrenheit, where there was no foam.

The temperature under the foams was 38 degrees F. These minimum temperatures were maintained for some time during the early morning. The 13 degree differential is much more than required for adequate protection.

Under the foam cover, there was virtually no damage to the fruit or foliage of the tomatoes. There was almost complete damage in the check plots without foam. In the latter case all fruit had frost blemishes and foliage was ruined.

In 1967, foam with necessary characteristics—stability, consistency, density and expansion—was developed by Laurentian Concentrates Ltd., Ottawa. The foam gradually disintegrates over a period of 48 hours leaving only small traces with no apparent chemical damage from the residue.

As a result of the studies, scientists concluded that protein foams may eventually be obtained from the present formulation for the protection of fruit and other vegetables against frost overnight. It is also suggested that increased economy can result by using foams with greater expansion characteristics with reduced thickness.

What was needed most was development work on foams which could be readily and economically applied on a large scale by farmers and growers. Investigations were, therefore, concentrated on the engineering aspects of this problem. A result of this was the development of an experimental machine which shows promise as a commercial foamer.

This machine was used to test the possibilities of the foams to permit early spring planting. At Ottawa these tests were made on tomatoes. A manual unit for foaming has been temporarily assigned to Delhi Research Station, where similar efforts were made last spring to examine the possibilities of early planting of tobacco.

Other CDA research specialists who have assisted on this project are G. W. Robertson, agrometeorologist, L. H. Lyall, horticulturist, and Peter Voisey, agricultural engineer. ■

sans guère se crevasser ni s'affaisser. La mousse est stable et sa persistance dépasse de beaucoup la durée requise pour donner une protection efficace contre la gelée.

On a pu mesurer la valeur des essais par des thermomètres et par l'évaluation du nombre de plantes survivantes. A cinq pouces au-dessus du sol en dehors du feuillage, la température était de 25°F dans les rangs non traités. Sous mousse, la température était de 38°F. Ces deux températures minimales ont duré pendant quelque temps à l'aube. La différence de 13°F ainsi obtenue est plus que suffisante pour servir de protection efficace.

Sous couverture de mousse, les tomates n'ont subi pratiquement aucun dégât, tant aux fruits qu'au feuillage; par contre, les plants non traités ont été presque totalement abîmés: tous les fruits avaient des taches de gelure et les feuilles étaient détruites.

En 1967, la compagnie Laurentian Concentrates Ltd., Ottawa, a mis au point une mousse dotée des qualités nécessaires: stabilité, consistance, densité, et dilatation. La mousse se désagrège petit à petit sur une période de 48 heures et ne laisse plus que de négligeables résidus apparemment inoffensifs.

Nous sommes maintenant d'avis que les mousses de protéine de composition semblable à celles utilisées dans les essais ci-dessus pourront servir à protéger les fruits et légumes contre les gels nocturnes. Il sera probablement plus économique d'utiliser des mousses moins épaisses mais à pouvoir de dilatation plus élevé.

Il fallait surtout savoir si les cultivateurs pouvaient utiliser ces mousses à une vaste échelle et de façon pratique et rentable. Nous avons donc concentré nos recherches sur les aspects techniques du problème. Il en est résulté une machine expérimentale prometteuse pour la fabrication commerciale de la mousse.

Cette machine a servi à nos expériences sur les plantations hâtives du printemps: à Ottawa, les essais ont porté sur les tomates. Un matériel approprié a été provisoirement fourni à la Station de recherches de Delhi, où des expériences semblables ont été faites le printemps dernier en vue d'examiner les possibilités de la plantation hâtive du tabac.

MM. G. W. Robertson, agrométéorologiste, L. H. Lyall, horticulteur et Peter Voisey, ingénieur agricole, du ministère de l'Agriculture du Canada, ont collaboré aux recherches. ■

WHITE BEANS: BRONZING LINKED WITH AIR POLLUTION



1

G. M. WEAVER, J. W. AYLESWORTH
AND H. C. DASS

Bronzing or sunscald, is recognized as a major production problem by white bean growers in Ontario. The disease is widespread in Huron, Kent, Middlesex and Elgin counties where most of the 116,000 acre crop is produced. Bronzing has continued to increase in severity and, when brought to our attention, was conveniently catalogued under the nondescript heading of a physiological disorder.

Dr. Weaver is head of the horticulture section and Dr. Dass is post-doctoral fellow, National Research Council of Canada at the CDA Research Station, Harrow, Ont. Mr. Aylesworth is officer in charge at the CDA Soil Substation, Woodslee, Ont.

SYMPTOMS

Symptoms of the disorder were first described in 1918 and its origin was later attributed to the short wavelength light in solar radiation. Bronzing in white beans occurs in the interval between flowering and maturity. It is characterized by premature yellowing or chlorosis and subsequent abscission of the older leaves. The younger fully expanded trifoliate leaves show varying degrees of necrotic stipple which is bronze in color and confined to the upper surface of the lamina (Fig. 1). Immature leaves are generally not affected. The developing bean pods may show necrotic lesions and these often parallel the direction of the outer fibers on the pod sheath (Fig. 2). Reduced seed set and yellowing, and dropping of pods are associated with this disorder.

OCCURRENCE

Symptoms appear in the field during the second and third week of August in association with a period of sultry weather. Continuous monitoring of air at several locations in the bean growing area has established the coincidence between the onset of bronzing and the prevalence of ozone at concentrations up to 9 pphm (parts per hundred million). Our research at the CDA Research Station, Harrow, Ont., revealed that this association has special significance since the bronzing disorder has been

Fig. 1—Foliar symptoms of bronzing. Necrotic stipple confined to upper surface of Sanilac leaf.

Fig. 2—Necrotic lesions on Sanilac pods caused by ozone treatment at 40 pphm for 30 minutes.

Fig. 3—Tolerance to bronzing illustrated in left foreground by 7793-593-2A (Clipper \times Sanilac) compared to sensitive Seaway plants in right foreground.



induced in the laboratory by exposure of bean plants to ozone concentrations of 8 pphm for a duration of six hours. And, after two years of research at Harrow, we have successfully duplicated field symptoms.

CONTROL

Establishing the cause of a major production problem is rarely as challenging or difficult as its control. In this instance, we found that three approaches offer some measure of control: (1) reduction of the level of pollution; (2) application of chemical protectants and (3) the breeding of tolerant varieties.

Consider briefly the problem of pollution. In view of the peripheral industrialization of southwestern Ontario by such major manufacturing cities as Cleveland, Toledo, Detroit and Sarnia, it is not surprising that we should sustain crop damage as a result of air pollution by photochemical smog. Under the influence of sunlight, the oxides of nitrogen react with oxygen in the presence of hydrocarbons to yield abnormally high levels of ozone. Temperature inversions may compress the smog to the earth's surface thereby preventing escape of the toxic gases to the upper atmosphere. The resulting high concentration of ozone interacts with living plants to cause damage such as bronzing in beans. Reduction in the level of pollution is desirable, but with increased

urban sprawl and industrialization this method of control may prove too great a challenge.

Fortunately the researcher can rely on two alternative approaches. Our research shows that when certain chemical compounds such as ascorbic acid (Vitamin C) and nickel dibutyl dithiocarbamate are dusted on the foliage, they act as protectants. They combine with the ozone and reduce the concentration in the air to a tolerable level. At present the practice of field-scale protection of crops by this means seems remote, since large quantities of the chemical must be applied.

We are more hopeful of the genetic approach through plant breeding. High levels of tolerance have been identified in such white bean varieties as Corvette and Clipper. Neither of these varieties are of economic importance, due to their unfavorable maturity, growth characteristics and seed quality. The tolerance to bronzing must be combined through hybridization and selection with the desirable agronomic characteristics which are common to popular varieties such as Sanilac and Seaway. We have made some advances in this direction and a number of selections such as 7793-593-2A (Fig. 3) appear sufficiently promising to warrant widespread regional testing. Growers who have sustained severe crop losses from bronzing should avoid such extremely sensitive varieties such as Seafarer and Seaway and plant Sanilac or the later maturing release Harkell, until improved strains can be made available for commercial planting. ■



GRAPE PHYLLOXERA IN ONTARIO

A. B. STEVENSON

The grape phylloxera is a tiny, aphid-like insect of North American origin. It was introduced into France about 100 years ago and achieved world-wide notoriety for its destructiveness to the very susceptible vinifera-type grapevines grown there. To save the famed French wine industry, the European grapes had to be grafted to rootstocks developed from North American species of grapevines. Most grapes grown in Canada are not as seriously damaged and it is possible to produce a crop of the fruit, for many years, despite the attacks by this insect. At the CDA Research Station at Vineland in 1960, we began a study of the biology and behavior of the phylloxera, and the effects of sub lethal infestations on grape production in Ontario.

The phylloxera causes two types of injury to grapes: conspicuous galls on the leaves; and gall-like swellings or nodosities on the roots. It can live on the roots of all of our common cultivars in Ontario, but it is only on certain ones, especially some of the French hybrids, that the leaf galls are found. Leaf galls are also found on wild grapes that are common throughout the Niagara Peninsula.

Although the phylloxera has always been present in Ontario it has caused relatively little concern until the introduction of the French hybrids, which are related to the very susceptible European grapes. The hybrids proved to be susceptible to phylloxera leaf galling as well as to root injury. The vine growers in Ontario found that the French hybrids and various other cultivars (cultivated varieties) grew better when grafted onto phylloxera-resistant rootstocks. Growers were also concerned with the poor vine vigor observed in many vineyards on heavy, poorly-drained soils and its possible relation to phylloxera damage.

Early in our research program we found that phylloxera occurred on roots in almost every mature vineyard in the Niagara Peninsula. Unfortunately, we could not correlate the size of phylloxera populations with poor vine growth. These insects were less prevalent on vines growing in sandy loam than in the clay and clay loam soils on which most of our vineyards are located, and healthier vines seemed capable of supporting higher populations of the pest because of the plants' more active root growth.

Dr. Stevenson is an entomologist at the CDA Research Station, Vineland Station, Ont.

In common with other insects of its kind, the phylloxera has a complex life cycle. It can live indefinitely on the roots of vines and continue the infestation from year to year regardless of whether the foliage is infested or not. The leaf gall form, however, depends each year for its establishment on stages of the insect that were developed on the roots the previous year.

Our studies of the seasonal development of leaf and root forms revealed a factor, common to both, that appears to help prevent serious losses; the population of both forms of the insect are relatively low at the beginning of the growing season. By the time they have reached potentially damaging levels, the vines have completed much of their seasonal growth.

Most of the phylloxera found on roots are wingless females. They apparently reproduce without males, laying large numbers of eggs that hatch into young crawlers, and then attack very young rootlets near the growing tip. They overwinter on the roots as an immature, wingless insect called a *hibernant*. We found that hibernants were very numerous at the end of the season, but up to 98% of them died during the winter.

Four to five generations of the phylloxera develop on the roots during the summer, causing increased galling to the roots until just before the crop matures. In summer, some of the root phylloxera develop into winged adults and migrate above ground. The activities of these adults are considered important because they are indirectly responsible for next year's foliage infestation and are the only winged stage developed by the insect. We found winged adults from late July until some time in October. They are most numerous about mid-September. Most of them do not appear to move very far from the vines, but small numbers could be dispersed by the wind.

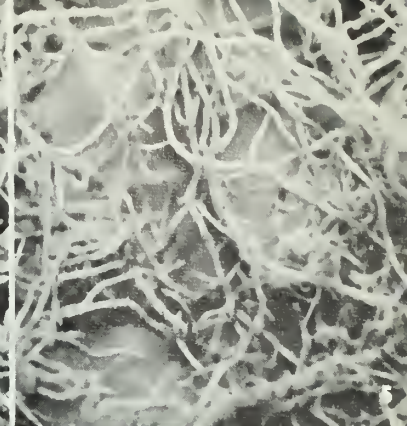
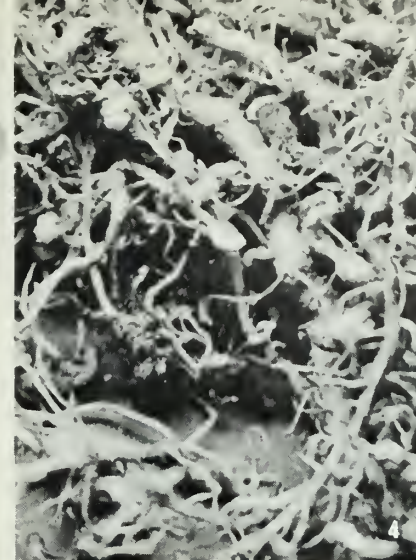


Fig. 1—Single phylloxera leaf gall in side view; upper surface of leaf visible.

Fig. 2—Necrotic spot on leaf of Foch grape caused by strain of grape phylloxera not capable of galling this cultivar.

Fig. 3—Shoots of wild grapes infested by the leaf form of the grape phylloxera (left and centre); healthy shoot (right).

Fig. 4—Grape roots infested by grape phylloxera.

Fig. 5—Healthy roots.

The winged adults lay eggs that develop into wingless males and females. These forms do not cause any damage. They mate, and the fertilized female lays an egg that overwinters on the wood of the vines. The winter eggs hatch into wingless females called *fundatrices* causing the first leaf galls the following spring.

The seasonal development of phylloxera on the leaves presents a picture similar to that on the roots. Leaf galls begin to appear soon after the new shoots start to grow. They are very scarce at first and likely to escape notice. Each gall normally contains one wingless female that can lay up to 500 eggs. After 2 or 3 generations, the galls become quite numerous and conspicuous, causing considerable damage to the young leaves developing after mid summer.

There are 5 to 6 generations of phylloxera on the leaves during the summer. The population of insects increases greatly with each generation. In the later generations, many insects fall, drop, or are blown from the vines to the soil. Some of these find their way to the roots, thereby increasing the root population, or, in some cases, establishing an infestation on previously healthy roots.

We found that the leaf galling stage of phylloxera had some natural enemies, but there did not appear to be enough of them to reduce the number of galls appreciably. The maggot of a tiny fly called *Leucopis* was the most common predator found in the galls.

To complicate matters, we found that there are different strains of phylloxera in the Niagara Peninsula. At least two strains were distinguished by their effects on the French hybrid cultivar, Foch. Phylloxera, collected from galls on the leaves of several other cultivars, could not produce galls on the leaves of Foch. Instead, tiny necrotic spots were developed wherever the insects had tried to feed. Yet leaf galls were often seen on Foch in the vineyards, and phylloxera collected from Foch were able to make galls on other cultivars. We found that at least 84 experimental cultivars were infested by the leaf-galling form. There may be several strains of phylloxera amongst these cultivars, though they have not been investigated.

Once the roots of a vineyard are infested, chemical control is difficult, if not impossible. In some experiments we found that root injury could be reduced substantially by drenching the soil with the insecticide Baygon. However, the treatment did not work well under all conditions and does not appear to be practical for general use.

Damage to the leaves can be reduced by spraying the vines with the insecticide endosulfan. This insecticide can be applied in the regular pre-bloom or post-bloom spray, and one application should be sufficient if good coverage is obtained.

In our experiments, where either root or leaf injury was reduced by insecticides, we found no definite increases in yield in the year the treatments were applied. We do not have any experimental results on the effect of a control program continued for more than one year.

Though little can be done to reduce damage by phylloxera in infested vineyards, future plantings may be protected. Certain cultivars should be grafted to resistant rootstocks such as *Riparia* × *Rupestris* 3309. Also, it may be possible to prevent the introduction of phylloxera to new plantings by efficient control of the leaf form, but we need to know more about the winged adult and winter egg portion of the life cycle to be certain of this.

The project on grape phylloxera has achieved its main objectives. It has shown that the insect is not causing serious losses to the main grape crop in Ontario, but that it may be considerably more destructive as new cultivars become more widely planted in the Niagara Peninsula. ■

Fig. 1—A variety grafted to *Rubus henryi* to detect presence of virus diseases.



FOR THE ATLANTIC REGION

D. L. CRAIG

The prime factors that have prevented the establishment of a red raspberry industry in the Atlantic region are perishability during transportation to distant markets; low yields due to virus diseases; and the lack of a variety that possesses both winter hardiness and the fruit characteristics desired on the export market.

Red raspberries can be found growing wild in virtually all areas within the region. We have found that they bear fruit well, which suggests that the environment is suitable. The testing of varieties by the Research Stations in the Atlantic area substantiates this suggestion for they have clearly shown that certain varieties are productive and hardy. The problem is not as much one of growing, as one of disposal of the fruit. There are very few large population centers in the area so we cannot expect large quantities of fresh fruit to be consumed locally. Fortunately, an answer to the problem appears to be emerging. Air shipment of fresh fruit to the markets on the Atlantic seaboard of the U.S.A., and the utilization of the new freezing plants, recently constructed in the area, seem the most promising directions in which to move.

At the Research Station in Kentville we have studied the varieties that are currently available. We

have found that they are not quite good enough. This is especially true if we hope to capitalize on the fresh fruit export market. The old varieties such as Latham and Trent are quite suitable for local fresh fruit markets and jam, but jam is not a profitable operation on which to base an industry in this area. Berries for jam can be imported from Europe cheaper than they can be produced here.

The hardy varieties in this region produce berries that are too small and soft to be ideal for fresh fruit exporting. In contrast the varieties that do produce large, bright firm berries are too winter tender. These varieties (e.g. Canby, Fairview, and Willamette) were developed on the Pacific Coast, so it is not surprising that they are not completely adaptable to the Atlantic region. The need is to combine the superior fruit qualities of the Pacific Coast varieties with the hardiness of varieties like Latham and Trent.

Breeding to improve the red raspberry began at Kentville on a small scale in 1953, and was initially aimed at determining which varieties would be most useful in a breeding program. From those initial crosses several seedlings were selected and the most promising were tested in a number of locations in the Atlantic region in 1967. One of these selections was named Avon. Avon's parents are Malling Promise from England, and the American variety Cuthbert, which is best known for its superb quality. Avon produces very large, firm, attractive berries, but there is still some question about its ability to completely survive our most severe winters.

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In 1966 we intensified our red raspberry breeding program, because improved transportation, availability of markets and the possibility of processing by freezing are providing a firm basis for an industry.

We have made many crosses and will make many more. These crosses have produced promising seedlings which must now go through the various testing stages. Breeding a new variety of red raspberry is a time consuming procedure. Twelve years will elapse from when the cross was made until the breeder can say his selections are superior or inferior to the varieties currently available.

Red raspberries have not been as intensely bred as some of the other fruit crops. We feel that we can make improvements and so will continue with our effort to provide our growers with the improved types that will enable them to capture new markets.

Weeds are another problem. In the past, many growers have given up raspberry growing because of weeds—especially the grasses. There can be no doubt that weeds have been a contributing factor to the low acreage of red raspberries in the Atlantic region. Chemicals have now changed this picture completely, provided the grower prepares his land properly prior to planting. If all grasses are eliminated, there is no reason why weeds should ever be a problem in the raspberries planted in that soil. Three chemicals (simazine, paraquat and dalapon) will insure this if applied as directed by the manufacturer.

It is probably safe to say that many growers in the world's principal raspberry production areas would be out of business were it not for the weed controlling chemicals—especially simazine.

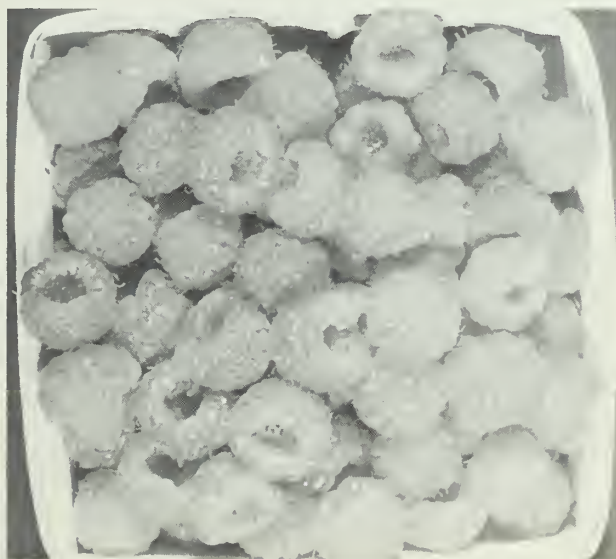
Important virus diseases are recognized by this fact: prior to 1960 virtually all of the red raspberries growing in Eastern Canada were infected with one or more virus diseases. The effect was to reduce



Fig. 2—Raspberry stocks protected from virus-carrying insects by the Kentville Research Station screenhouse.

yields so that production was unprofitable. With new disease-free stocks, one American researcher reports that virus-free Newburgh produced 105% more canes per plot and yielded 117% more fruit than Newburgh infected with mosaic virus. The discovery of the insect responsible for the spread of virus diseases and its method of control was a most significant finding. The additional discovery of a method whereby the virus disease can be eliminated from an infected plant by means of heat therapy has made it possible to completely rejuvenate old varieties. This has led to plant certification schemes which virtually insure the grower a source of healthy plants. In the Atlantic region, the Kentville Research Station and the Provincial Department of Horticulture and Biology Services share this responsibility. In the spring of 1968, our raspberry nurserymen were able to purchase Foundation stock from a select grower and then propagate it for the commercial producer and home gardener. But it will be 1970 before this certified stock will be available. ■

Fig. 3—Avon (left) superior to Latham (right) in size and firmness.



PRESERVATION TECHNIQUES INCREASE VIABILITY OF DAIRY STARTER CULTURE

The Food Research Institute Develops Methods for Extending the Viability of Frozen Lactic Acid Cultures for Use in Dairy Manufacturing

G. B. LANDERKIN

Lactic acid cultures are employed principally in the production of cheeses, buttermilk and cultured sour cream in Canada. Normally, starter cultures are obtained from a specialized source in a liquid or powdered form requiring two or more propagations before they may be used in the dairy manufacturing plant. Then cultures are propagated by daily or tri-weekly transfer within the plant, according to production schedule requirements. This method requires painstaking care to prevent bacterial contamination, change in character of mixed strain starters, mutations and inadvertent bacteriophage infection. One, or a combination of any of these may cause a loss of starter activity or the development of undesirable flavors, or other defects in the finished product.

The replacement of faulty starters demands time and money and usually results in losses in production that might be reduced considerably if a series of cultures could be stored in the plant available for replacement at the first indication of trouble. It is for this reason that we started investigating, in the Food Research Institute, the methods for extending storage of active lactic acid cultures for dairy manufacture.

While the freezing and storage of cultures in liquid nitrogen or their lyophilization (freeze-drying) are

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both optimal for maintaining the lactic acid bacteria unaltered for extended periods, both methods require expensive equipment for their preparation. These methods generally apply to small volumes, either vials or ampoules. In addition they require trained personnel and good laboratory facilities for sub-culturing and reactivation. Their commercial application is therefore restricted to those larger plants having bacteriological laboratories.

Many types of microorganisms may be preserved by freezing over a wide range of temperatures from 0°F downwards. The frozen storage of lactic cultures is of special interest, for if a high percentage of the initial population survive prolonged storage, any change in the character of the starter will be minimized. With fewer transfers of the mother culture there is less likelihood of contamination and a longer period before one strain becomes dominant in a multiple strain starter.

In our investigations at Ottawa, we made initial trials to determine the viability and subsequent activity in reconstituted skimmilk of sixteen strains of *Streptococcus lactis*, *S. cremoris* and *S. diacetylactis* after freezing and storage at 0° and -10°F for periods of up to 24 weeks.

Fig. 1—Materials for neutralizing lactic cultures prior to freezing.

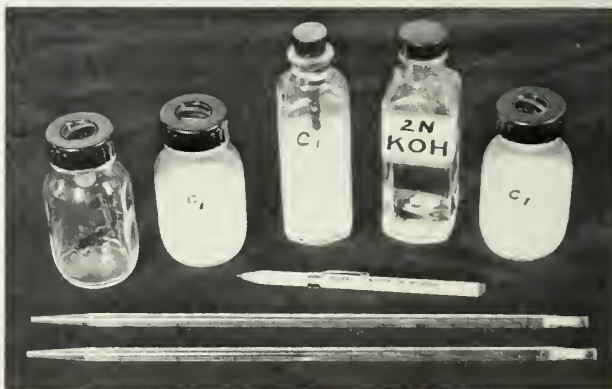




Fig. 2—Inoculating sterile milk in nurser bottle.

We found that the numbers of surviving bacteria decreased with increasing time in storage and in general the survivors were fewer at the higher storage temperature. Differences among strains were highly significant after 24 weeks, ranging from almost 0 to 29% survivors at 0°F and from 2 to 38% at -10°F. Activity tests corresponded to bacterial survival estimates. When the per cent viable cells decreased to 5% of the initial count activity was unsatisfactory. We concluded that with mixed strain starters a balance of compatible strains with equivalent survival abilities would be required for commercial acceptance of frozen cultures.

Methods for increasing the viability of frozen lactic cultures were now considered, since extended survival of all strains could help to prevent an upset in the balance of mixed strain starters. The effects of protective additives shown beneficial in reducing freezing damage to other living cells were therefore studied with lactic streptococci.

In this experiment 3 single-strain cultures, one each of *Streptococcus lactis*, *S. cremoris* and *S. diacetylactis* were chosen, and after three propagations one ml of each ripened culture was inoculated into 99 ml of sterile suspending media. Media for freezing were skim milk (10% T.S.) with or without each of the following additives: glycerol 10%, dimethyl-sulfoxide 10%, acetamide 0.5 and 2%, succinimide 0.5 and

l-malic acid 0.5 and 2%. In addition skim milk powder was added to commercial apple juice containing 0.4% malic acid. All media were brought to a pH of 6.8 and dispensed into vials prior to sterilization. Four vials of each treatment were frozen and stored at -10°F; frozen 5 min. in liquid nitrogen at -320°F then stored at -10°F; and frozen and stored in liquid Nitrogen at -320°F.

Our research revealed that cultures frozen and stored at -320°F in liquid nitrogen gave the greatest recovery of viable cells followed by those frozen immediately in liquid nitrogen then stored at -10°F and lastly by those frozen and stored at -10°F. Additives did not increase the per cent survival of cells frozen and stored in liquid nitrogen; however with strains of *S. lactis* and *S. cremoris* frozen and stored at -10°F their effectiveness was significant though to a lesser extent when initially frozen in liquid nitrogen. L-malic acid and apple juice were the best additives, although neither increased the survival of cells of *S. diacetylactis* significantly, both stimulated acid production during incubation following thawing.

Since 2% l-malic acid and apple juice allowed 60% survival of *S. lactis* and *S. cremoris* following freezing and storage at -10°F for six months, we made further studies using additives chosen from the tri-carboxylic acid cycle so important in intermediary cellular metabolism. The same three cultures were tested in skim milk with additions of 2% malic, fumaric, succinic or citric acids in both the ripened and neutralized states (pH 6-8) and frozen in a glycol bath at -10°F. Maximal survival of all 3 strains occurred in neutralized cultures.

All strains survived in greater numbers with additives present and the order of effectiveness was succinate, fumarate, malate and citrate. After 39 weeks frozen storage at -10°F, 80% survival was found for *S. lactis* in neutralized culture with added succinate. Under the same conditions the per cent survivals of *S. diacetylactis* and *S. cremoris* were 76 and 66 respectively. In ripened skim milk cultures without additives for the same period, percentage survivals were 41.7, 7.2 and 0.2 and when neutralized the values were 66, 32 and 3.5, clearly indicating the beneficial effects of succinate in retaining the viability of lactic organisms in frozen storage.

Investigations are continuing on improvements in freezing techniques at the Food Research Institute. The results to date indicate that the addition of 2% l-malic acid to skim milk or the reconstitution of skim milk powder in apple juice will give a satisfactory culture if incubated and neutralized prior to freezing. Cultures so prepared may be stored for up to five months at -10°F without serious loss of activity.

Stepwise directions for the preparation of neutralized starters for freezing in nurser bottles are available from the Food Research Institute, CDA Research Branch, Ottawa. ■



Fig. 1—65% leaves
35% stems

50% leaves
50% stems

35% leaves
65% stems

CHEMICAL CONSTITUENTS VARY IN ALFALFA

D. H. HEINRICH

Alfalfa is one of the best fodder crops for cattle and sheep. It yields well and produces nutritious forage. In the past, alfalfa breeders have been concerned mainly with improving the crop for disease and insect resistance, and for winterhardiness in northern regions. Very little attention has been given to selection for chemical constituents of various kinds. When grazed, alfalfa occasionally causes bloat in ruminants, which is considered to be one of its disadvantages. Investigators at the Summerland Research Station have shown that high 18-S protein content may be partly responsible for high bloat incidence. It is quite possible that certain other of the chemical constituents may be associated with the bloat problem. For this reason and from the general feed use point of view, it would be desirable to obtain more information on chemical composition of alfalfa

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so that strains could be developed which would be more suitable for a particular use such as alfalfa meal, silage, hay or pasture.

A research program is underway at the CDA Research Station, Swift Current, Saskatchewan, investigating the variation of chemical constituents in large populations of alfalfa that have a wide genetic base. We have found that plants varied widely in content of crude protein, crude fibre, fat, phosphorus, potassium, magnesium, calcium and sulfur. For any of these, it should be possible to develop strains, high or low, for that constituent by breeding and selection, if this is considered to be a desirable change.

To illustrate what possibilities exist for changing the chemical composition of alfalfa, let us consider crude protein content which displays typical variation (Fig. 1). The crude protein content in leaves at the early-flowering stage of some plants at the low end of the range was 23%, and at the high end of the range it was 35%. This represents a difference of 52% between the "low protein" plants and the "high protein" plants. In the stems the crude protein content varied from a low of 7% to a high of 13%. This is a difference of 86% between the "low protein" plants and the "high protein" plants. If it is assumed that the ratio of leaves to stems is 1:1, which is a generally accepted figure, and we can incorporate high or low protein into both leaves and stems in the same plants, then we can expect to develop "low protein" strains

that would contain $\frac{23+7}{2} = 15\%$ protein and "high protein" strains that would contain $\frac{35+13}{2} = 24\%$

protein. This is a difference of 60% crude protein content between the low and high strains.

We have also found that leaf to stem ratio in different plants varies from a low of 1:2 to a high of 2:1 (Figs. 2 and 3). Therefore, if we selected plants low or high in leaf to stem ratio along with low or high protein content of leaves and stems, we might come up with plants that contained as little as 10% crude protein and as much as 31% crude protein.

These considerations are theoretical, but probably could be realized if we practised rigid selection in one direction or the other. A "low protein" strain may be what we want for pasture, and a "high protein" strain for alfalfa meal.

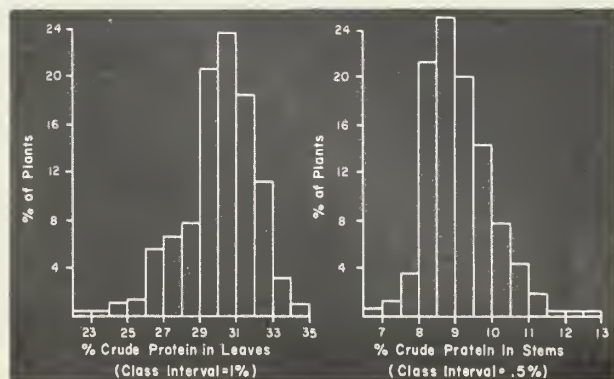


Fig. 2

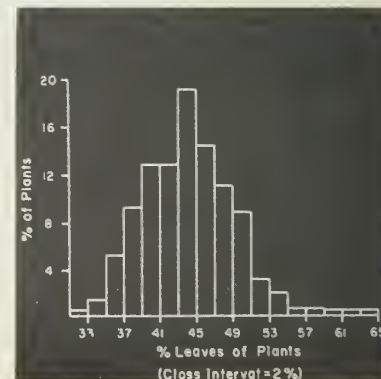


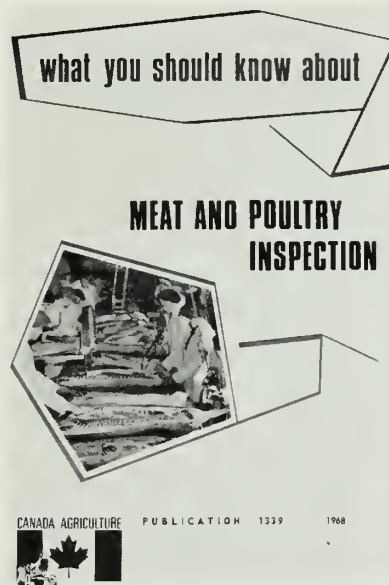
Fig. 3



PUBLICATIONS

Copies of these, and a list of other publications may be obtained free of charge (unless otherwise stated) from: Information Division, Canada Department of Agriculture, Ottawa.

On peut obtenir gratuitement (à moins d'avis contraire) des exemplaires de ces publications ainsi qu'une liste d'autres publications à: la Division de l'information, ministère de l'Agriculture du Canada, Ottawa.



A SERVICE TO SCHOOLS

The demand for information about agriculture for school projects has prompted the production of a new series "What You Should Know About . . ." The publications are designed specifically for grades 6 to 10. They explain briefly the fundamental principles of agricultural practices with many illustrations and pictures. A special distribution policy has been established. Unlimited quantities will be provided to schools when ordered on school letterhead or if the letter is signed by a teacher. The publications listed below will be available in 1969. Other subjects will be available in the future.

- 1338 What You Should Know About Soil
- 1339 What You Should Know About Federal Meat and Poultry Inspection
- 1340 What You Should Know About Pest Control
- 1350 What You Should Know About Fruit Production
- 1351 What You Should Know About Farm Woodlots

AU SERVICE DES ÉCOLES

La demande de renseignements sur l'agriculture de la part des écoles a incité le Ministère à produire une nouvelle série de publications intitulée «Qu'en savez-vous?», et qui sont destinées aux élèves des sixième au dixième cours. On y explique brièvement les principes fondamentaux des pratiques agricoles en utilisant de nombreuses illustrations et photos. On a établi à leur égard un programme spécial de distribution. Les établissements d'instruction pourront obtenir toutes les copies qu'elles désirent pourvu que demande en soit faite sur une feuille avec en-tête de l'école et signée par un instituteur. Les publications dont la liste suit seront disponibles en 1969. D'autres sujets suivront.

- 1338 Qu'en savez-vous Le sol?
- 1339 Qu'en savez-vous L'inspection fédérale de la viande et de la volaille?
- 1340 Qu'en savez-vous Les antiparasitaires?
- 1350 Qu'en savez-vous La production des fruits?
- 1351 Qu'en savez-vous Lot boisé?



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